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JOURNAL *of* EDUCATIONAL RESEARCH

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A SYMPOSIUM ON THE CLASSIFICATION OF EDUCATIONAL RESEARCH

(Continued from the May issue)

A. S. BARR,

JOHN C. ALMACK, FRED C. AYER, J. F. DASHIELL, ARTHUR I. GATES, CARTER V. GOOD, PALMER O. JOHNSON, TRUMAN L. KELLEY, WILLIAM A. MCCALL, G. M. RUCH, PERCIVAL M. SYMONDS, HERBERT A. TOOPS, M. R. TRABUE, F. L. WHITNEY, AND CLIFFORD WOODY

Critics: WILLIAM H. KILPATRICK, V. A. C. HENMON, AND FRANK N. FREEMAN

M. R. TRABUE

Attempts to classify research may be pernicious in their effects upon research, for they may easily over-emphasize the differences that arise from viewing the various parts of the process rather than reveal the fundamental character of research itself. Students should recognize that the essential nature of research is the same in all fields, and that the underlying principles of research are to be found by looking for common elements rather than for differences. Confusion and distrust are certain to arise from partial views of the research process, while helpful understanding and mutual confidence among research workers in different fields are attainable through serious efforts to see the fundamental thought processes and attitudes which characterize and are common to all research.

The essential attitudes of the research worker and his characteristic alternation between the inductive and deductive modes of thinking are the same, regardless of the data or of the field of his research. To speak of the questionnaire method, the experimental method, the case method, or the statistical method of research gives entirely too much recognition to the special means by which certain steps in the research process are sometimes taken. To say that one person uses the psychological method, another the historical method, and still another the legal method of research puts far too much emphasis on differences in the special fields in which these investigators are working and hides from consciousness

the much more important fact that each of them is using essentially the same mental program in solving his problem.

Whether data are being obtained by means of questionnaires, by means of tests, or by means of extensive reading in a library, the essential fact is that pertinent data are being collected. Whether data are being organized in chronological order, in logical categories, or by means of statistical processes, the important requirement is that they be treated in such ways as will bring out their true significance. While it is necessary to be sure that appropriate data are being collected intelligently and interpreted correctly, it is neither necessary nor desirable that the research itself be called by the name of a special tool for collection or of a special method for interpretation. Different problems and fields of knowledge may require the use, in certain steps of the program, of distinctive data and specialized tools, but the steps to be taken and the attitudes characterizing the investigator who takes them successfully are essentially the same in all research problems.

Although each step in research makes its own special demands on the character of the investigator, certain important characteristics are essential to success in all stages of all research projects. One who would do research must be so deeply interested in his field as to be convinced that knowledge of and ultimate control of its phenomena are vitally important. One must possess a strong desire to understand the fundamental principles underlying phenomena in the field. One must be sufficiently intelligent to recognize clearly the interrelations and functions of different elements in the total situations involved. One must possess an impersonal, open-minded attitude that seeks the truth, regardless of its effects on one's personal fortunes and prejudices. That theory or generalization which harmonizes most completely all the available evidence must be given recognition and allegiance until new evidence makes a modified theory more plausible. The special field in which one conducts research does not alter the necessity that in his own field, at least, one must possess all these attributes in high degree.

In addition to the attitudes which in every field are necessary in all stages of research, each step in a research program requires certain special attitudes as well as special tools and methods. It would seem only a little less sensible to classify a research project in terms of the special attitudes required of the investigator in taking a particular step in the process than to classify it in terms of the special tools and methods used in a single step of the process. Aside from purely academic desires

for an attractive classification of research methods, the most helpful way for students to think about research is in terms of the general sequence in which various mental processes occur in a complete program of research, with only minor attention to the special tools or methods and to the special attitudes appropriate to each process.

I have found it instructive to note eight steps or stages in the development and solution of a research problem, although a smaller number may readily be listed by omitting the first and the last steps and by telescoping some of those in the middle of the series. Research does not always progress by entirely separate and distinct steps, for an act which is concerned primarily with one step may contribute extensively to earlier or to later steps in the process. The mind of the investigator frequently plays back and forth over the whole series of steps, much as the hands of an organist play back and forth over his keyboard. In each research, however, one may distinguish the following activities, each of which is accomplished by means of appropriate special tools and techniques (depending upon the character of the problem and the data) in the hands of an investigator who possesses the necessary special attitudes and attributes.

SEQUENTIAL STEPS IN RESEARCH

Special Tools and Methods Used (Varying with the problem)		*Special Attributes and Attitudes* (In addition to those which are common to every step)
1		
GROWING FAMILIARITY IN THE FIELD		
Reading	Observing	Attention
Listening	Utilizing	Earnestness
2		
INCREASING AWARENESS OF UNSOLVED PROBLEMS IN THE FIELD		
Reflecting	Testing	Thoroughness
Surveying	Comparing	System
3		
SELECTION AND ANALYSIS OF A SPECIAL PROBLEM		
Defining		Mastery
Analyzing		Independence
Comparing		Perception

4

FORMULATION OF PLAUSIBLE HYPOTHESES

Reviewing	Restating	Imagination
Reorganizing	Conjecturing	Originality
		Courage

5

SELECTION AND COLLECTION OF DATA

Experiment	Questionnaire	Technical knowledge
Measurement	Correspondence	Technical skills
Observation	Recording	Judgment
Interview	Reading	Honesty

6

ANALYSIS, EVALUATION, AND ORGANIZATION OF DATA

Statistical	Technical skills
Chronological	Insight
Functional	Sincerity
Logical	
Individual (Case)	

7

TESTING TENTATIVE CONCLUSIONS

Repetition	Technical skills
Experiment	Patience
Analysis	Restraint
Observation	

8

REPORTING CONCLUSIONS

Language	Order
Pictures	Lucidity
Graphs	Modesty

F. L. WHITNEY

I. Historical Research

Hogan, F. P. *The History of the Fresno State Teachers College*, Master's Study, Leland Stanford Junior University, 1929.

II. Descriptive Research

Wiechman, Janet B. *A Survey of Equipment and Materials Used in Social Studies Departments of the Los Angeles Junior High Schools*, Master's Study, University of Southern California, 1929.

III. Experimental Research

Jaffe, S. S. *An Experimental Study of the Part-Whole Method of Learning,* Master's Study, College of the City of New York, 1929.

IV. Philosophical Research

McCall, W. M. *A Critical Review of Various Conceptions Underlying Curriculum Making,* Master's Study, University of Missouri, 1926.

V. Predictive Research

Frutchey, F. P. *Some Factors in Determining High School Success,* Master's Study, Colorado State Teachers College, 1930.

This classification is from the point of view of the general method of the science-philosophy process, the process of reflective thought. It provides for the six steps involved in thinking as analyzed by Dewey (*How We Think*) and Kelley (*Scientific Method: Its Function in Research and Education*).

In an attempt to locate and define a felt need and to solve the problem presented, it may be desirable (1) to establish past status, to determine *historical* trends, (2) to make *descriptive* checks of present conditions by means of a survey, (3) to find out how the factors involved are working through *experimentation,* (4) to carry the findings of fact obtained on to higher levels of thought and work them over and restate them as larger and larger *philosophical* concepts resulting from additional scientific generalizations available, (5) and to "appraise this new solution in the light of future needs" (Kelley) by *prediction* of future status on the basis of trends of occurrence or relationship found.

Every educational research project does not, of course, employ all of these five methods. The procedure of each of the small masters' studies cited above is rather distinctly that of the method of research under which it is subsumed. It will be understood, however, that the experiment (III) must employ description (survey, testing) in checks of initial and of final status of the experimental factor and other variables involved, that the concepts constituting the raw material of philosophy (IV) must originate on lower levels of the thinking process, and that prognosis (V) deals with any trends of scientific fact or philosophical generalization available in the realm of investigation in which the research worker is interested.

CLIFFORD WOODY

I. According to Source of Materials of Research
   1. Historic
   2. Laboratory-field

II. According to Techniques Employed in the Collection of the Data*
   1. Questionnaire studies
      (a) Letters
      (b) Inquiry or information blanks
      (c) Interviews
   2. Observational studies
      (a) Activity analysis
      (b) Job analysis
      (c) Analysis of recorded observed responses
   3. Experimental studies
      (a) Uncontrolled experimental
      (b) Controlled experimental

III. According to the Method of Treatment of Data
   1. Historic
   2. Philosophic
   3. Statistical

IV. According to the Nature of the Material *Per se*
   1. Historical
   2. Legal
   3. Administrative
   4. Instructional
   5. Personnel
   6. Curricular

V. According to Social Value of the Results
   1. Creative
   2. Routine

EDUCATIONAL RESEARCH

The term "research" implies a prolonged, careful, and painstaking effort to arrive at truth. It involves the definition of a problem, the setting up of hypotheses or suggested solutions, the elaboration of the hypotheses or suggested solutions, the evaluation and selection of the most tenable hypothesis or suggested solution, experimentation to determine whether the chosen hypothesis or suggested solution really provides a satisfactory solution under all circumstances, and finally the reaching of a conclusion. In last analysis, research represents the method of

*Survey and case studies may be classed in either category, depending upon the techniques used.

reflective thinking. Thus the method of work becomes the outstanding criterion for differentiating research and non-research activities.

Research activities may be classified on four different bases: the source of the materials of research; the methods of collecting these materials; the method of classifying, summarizing, and reaching conclusions; the nature of the research data *per se*, and the value of the contribution made. On the basis of source of materials, research may be classified into two types: the *historic type* and the *laboratory-field type*. In the former type the materials are all collected and are available in the form of books, documents, reports, laws, exhibits, articles in journals, statistical records; in the latter type, the material has to be collected either from the laboratory or in the field. The former type of research is sometimes referred to as "library research," implying that the main task involves the manipulation of materials already collected and available in a library or some other place of storage; the latter type is referred to as laboratory-field study, indicating that the data are not available and that they must be collected by some means from the laboratory or the field of educational endeavor concerned.

Research activities may be classified into the following types according to the techniques employed in the collection of data: *questionnaire* studies, *observational* studies, and *experimental* studies. Each of those types may be subdivided as follows: questionnaire studies into those based upon letters, inquiry or information blanks, or interviews; observational studies into those involving activity analyses, job analyses or other types of analyses of recorded observed responses; experimental studies into those involving both the uncontrolled and the controlled conditions. Studies involving the survey and the case study are rather general and may be classified under either of the three enumerated classes, depending upon the particular techniques employed.

There are three general types of research when classified from the point of view of the method of treating the data: *historical, philosophical,* and *statistical.* No discussion of this classification is necessary because these three methods are well recognized.

When considered from the nature of the materials *per se* upon which the research is based, it may be differentiated into types such as the following: *historical,* referring to materials relating to the history of education; *legal,* referring to materials from legal documents and reports; *administrative,* referring to materials dealing with the administration of schools; *instructional,* referring to data primarily involved in the eval-

uation of methods of instruction; *personnel,* dealing with facts concerning the teacher or pupil population; and *curricular,* involving those bearing upon the construction of the curriculum.

Lastly, research activities, when classified according to the social values of the results obtained may be classified in two groups: *creative* research and *routine* research. Creative research is research of the highest type and results in a socially significant contribution to knowledge. On the highest level, creative research involves a new problem and the utilization of a method especially designed for attacking this problem. Its contribution is two-fold: the results achieved and the method employed. However, research activities are usually accepted as creative if they result in either new knowledge or new methods. Routine research implies old problems, old methods, or both. Occasionally the repetition of an investigation for purposes of verifying conclusions previously reached is classed as creative, but contained repetition of any investigation is soon referred to as routine research. In routine research the problem or the method may be new to the one making the investigation but old to those of wider training and experience. Such research may result in real discoveries to the one responsible for it, but because they are already known to the world at large they have no social significance. Thus the real difference between creative and routine research lies in the social significance of the contribution made.

The enumerated classifications may be somewhat lacking in completeness and clear-cut distinctions. Not all types of research have been mentioned, but it seems that any types omitted will fit into the classification without difficulty. Some overlapping in terminology exists and differentiation between the types of research activities is not always clear, but when consideration is given to the criteria of classification, the meaning of the terminology is evident. For example, the term "historical" is used in three different categories; source of data, treatment of data, and nature of the subject matter *per se,* but there should be no confusion if careful consideration is given to the criteria involved.

The confusion in connection with the classification of research activities has resulted from three sources: the failure to recognize the existence of various criteria upon which research activities may be classified; the failure to recognize that the descriptive term refers to but one aspect of the research activity, and in no way precludes the existence of various criteria upon which research activities may be classified; the failure to see that almost every type of research exists in every other type. Every

research activity worthy of the name involves to some extent the historic, the philosophical, and the statistical method of treatment. Furthermore, every research activity may be thought of in terms of each of the other four bases of classification. If the one classifying these activities will simply state the basis of classification, the confusion in terminology will disappear.

WILLIAM H. KILPATRICK

Research is primarily careful and extended study with a fairly definite aim or problem implied. There may be as many different kinds of research as there are kinds of such study useful to distinguish.

For the purpose of this symposium we seem called upon to distinguish three kinds of research: scientific, historic, and philosophic. These three need not be thought of as mutually exclusive, they may and often will mutually overlap.

1. The scientific is here perhaps best thought of, typically, as the effort to find or establish a probability of expectation: When such-and-such conditions hold, what state of affairs may we expect therefrom and with what probability? The methods typically followed may be summarized as (i) the forming of an hypothesis; (ii) the testing of this by observation or experiment, and (iii) the statistical establishment of the degree of probability attaching.

2. The historical will hardly be made clearer by discussion. It can, in particular, be highly "scientific." If so, the expectation established is not as to the future course of the historic item studied, but as to what will be found by one who cares to study again into that item. Any reliability relates to this type of finding.

3. Philosophic research has in the popular mind been somewhat covered up by the recent vogue of "scientific" research. Some whose knowledge is confined largely to science and to the present seem mistakenly to suppose that the term research originated with modern science and is limited to statistics.

An illustration of philosophical research may perhaps best show what is meant. A typical instance might be the critical study, with a view to practice, of a certain conception, say of educational objectives. This might begin with a study of the various conceptions already in use in this field to ascertain their respective presuppositions and implications. These findings might then be criticized in the light of the best available theories

of the educative process and of the relation of learning to life, specifically perhaps to life in a country professing to be democratic. All of this to eventuate in a conception and scheme of educational objectives better if possible—and at least better understood—than any now available for use (say) in this country.

The multiplicity of values here involved, their manifold bearings on life, and their frequent disparateness all unite to make of this a "philosophic" problem.[1] As such it can never be solved finally. Nor is testing, in the control group sense, an available procedure for evaluating the validity or worth of the conception thus reached. At most, experiment and observation furnish data to be used in a reconsideration of the problem. Research of this sort, along with others of its kind, is both sufficiently significant and sufficiently frequent to warrant a classification to itself. This discussion will perhaps suggest if not indicate what in comparison is meant by philosophic research. That such an instance involves a problem and calls for careful and extended study is beyond question. That creative thought is both possible and necessary is equally clear. That the study can result in a considerable body of new and well-organized thought is further clear. The meeting of these varied conditions constitutes successful research.

V. A. C. HENMON

Quot homines, tot sententiae! Undoubtedly this is inevitable in so complex a field as education when independent classifications of methods of research are submitted without consultations or conferences. Even with them perhaps no scheme of classification could be arrived at that would possess logical exactness. Still more it seems unlikely that any general logical classification is possible and the best one can do is to consider the methods and techniques that are appropriate to and useful in each of the many divisions or fields into which education may be broken up, for example as illustrated by the analysis of administrative research in this symposium by Ayer.

To one who is in the days of his early excursions into philosophy and science was struck by the observation of Spencer[2] "Knowledge of the lowest kind is ununified knowledge; Science is *partially-unified knowl-*

[1] In a forthcoming article in this magazine I shall discuss at considerable length how a philosophic problem differs from a scientific one, and what accordingly constitutes philosophical research.

[2] Spencer, H. *First Principles*, Part II, p. 37.

edge; Philosophy is *completely unified knowledge*" and who learned from Karl Pearson[1] that "the unity of science consists alone in its method, not in its material," that this method is one and the same for all classes of facts—physical, mental or social—would question the logic of even so attractive a classification as the four distinct methods of research set forth by Kelley in the symposium and more fully in his *Scientific Method.* For if scientific method is one and the same in all branches and the essence of this method is the careful and orderly classification of facts, the recognition of their relationships and recurring sequences and the discovery of generalizations, principles or laws by the aid of creative imagination, then whether the facts are facts of the present or of the past or whether our concern is with present relationships or future eventualities, would not create fundamental distinctions in method. It may be convenient for many purposes to distinguish four methods of research: the dialectial or philosophical, the experimental, the historical, and the method of future estimation—but one may question whether they involve "radical differences in technique of research." It is difficult, for example, to see wherein the method of inquiry pursued by the historian in locating as completely as possible the original sources, in classifying the facts derived to show their relationships and sequences, and in drawing from them generalizations unbiased by personal feeling, differs essentially from the oft-quoted method of "systematic inquiry" pursued by Darwin, which issued in the greatest generalization that science has produced in the process of an ultimate unification of knowledge. Even the essential elements of the experimental method are not foreign to the procedures of the historian in his reclassifications and in the evaluations of his source materials.

The dichotomy between scientific method and philosophical method appears at first to represent a real distinction but the writer of this comment agrees with Almack that there is no philosophical method or technique of research which may be juxtaposed to scientific research. The inveterate desire to pierce the veil, to go beyond the limits of science to higher unities, gives us philosophy as a reflective study of experience. But all such attempts at unification are individual and so there are systems of philosophy which come and go while science goes on slowly forever.

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[1] Pearson, K. *Grammar of Science.* London: Adam and Charles Black, 1892, 2nd Ed. 1920.

These brief observations indicate that in the writer's judgment the search for a logical classification of methods of research seems futile. Perhaps the observation of Trabue is right that attempts to classify research may be pernicious. The factors in the educational process are 1) the individual, 2) the accumulated knowledge and culture of the race, and 3) the educational institutions—the home, the school, vocation, the church, and the state. Fruitful research concerning the dynamic relationship between these factors involves then, first, the collection of important and relevant facts—psychological, curricular, or institutional—for any given purpose. The facts will be secured in the variety of ways indicated by the contributors to the symposium ranging all the way from crude observations to exact experimental and quantitative determinations. Quantitative facts arrived at by actual experimentation wherever possible would, no doubt, be agreed upon by all as the ultimate desiderata. Second, the classification of the facts in a great variety of ways to reveal all of the relationships that may be pertinent to any purpose. Third, the discovery of generalization or laws, expressible again, as Ruch suggests, if possible in quantitative form, as equations or mathematical laws.

Educational research is much more likely to be troubled by the difficulty of fulfilling the commandment of science, *divide et impera*, than by confusion as to methods of research. Because of the number of variables we pass from one tentative conclusion to another and rarely if ever arrive at verities to which we can hold fast. We may be clear as to the methods to be pursued but the very complexity of our problems is constantly baffling.

Frank N. Freeman

There is some difference of opinion as to whether the attempt to classify research in education is a profitable undertaking. It may be desirable, therefore, at the outset, to canvass the reasons for making a classification. The full justification for a classification can be arrived at only after the classification has been made. At the outset even the possibility of making a classification may be questioned. Assuming that a suitable classification can be made, however, we may inquire what its use may be. A classification of types of research may be useful, in the first place, as a means of organizing and carrying on courses of training in preparation for research. If it should turn out that research can be

classified into clearly differentiated types, and if these types have different requirements, the preparation for prosecuting research of the different types will doubtless vary. The necessity of variation in preparation, then, constitutes at least a plausible provisional reason for attempting to make a classification.

In the second place, if types of research can be distinguished, it is quite probable that the different types are suited to attacks upon different problems. One type of research may be suited to attack one problem and another type to attack another problem. If we are faced with a particular educational problem, then, we should be able to choose the type of research which is suited to the investigation of that particular problem. We should not apply one form of investigation to attack a problem for which it is not suited. We shall be better able to judge whether such differentiation exists after reviewing the attempts to classify research and undertaking to set up a classification of our own.

THE DIFFERENTIAL MARKS OF RESEARCH IN GENERAL

Before attempting to distinguish between different types of research, it may be well to mark off the field with which we are dealing by attempting to distinguish between research and none-research. Difficulties sometimes arise in the classification of research from the difference in opinion as to what research itself is.

In defining research it is better at the outset to adopt a broad definition. In other words, it is better to include some procedures which are doubtful and then exclude them later if it seems desirable to do so. By including these doubtful cases at the outset we will not be in danger of omitting the considerations of some forms of research which ought to be included.

We may adopt the following as a provisional definition of research: Research is the attempt to discover and establish truths by one or more systematic methods. The process of arriving at an opinion is not necessarily research. It depends upon the basis of the opinion or the way it is arrived at. The individual who carries on research does not create truth, he finds it out. This implies an objectivity in truth. It implies that the truth may be demonstrated to all individuals who are able to comprehend the procedure by which it was arrived at. It implies that the truth was not hit upon by guess work, but is arrived at by systematic investigation.

How does this definition and description agree with other statements concerning the meaning of research? One statement which has been

made is that research is fact finding. Does this definition agree with this statement? It does if the term fact is interpreted broadly. A fact is usually thought of as particular, whereas truth is thought of as general. Truth may be made up of facts or may consist of an organization of facts. Truth which is not based upon facts cannot be considered the object of research, at least in the scientific sense of the word. But the discovery of truth is a better description of research than is fact finding because it implies an organization of facts, which should be the objective of research.

Another suggestion of the meaning of research is that it consists of straight, hard thinking. Again, research requires straight, hard thinking, but such thinking is not all there is to research. It leaves out of account the collection of facts or data which, in most cases, constitutes an essential element in research. Only that type of research which is devoted to logic or mathematics is mere straight, hard thinking. Other types of research include something beside thinking and this other something should be included in the definition.

Another issue which frequently arises, and which is mentioned by a number of contributors to this symposium, is the question whether philosophy is research. Some would include philosophy and some would exclude it. The question may be answered conditionally. If philosophy can be made to yield truth and if it can be pursued by systematic methods, we may consider philosophy as a form of research. If it cannot be made to yield truth in the sense in which this term has been used, and if it is not pursued by systematic methods, it will be excluded by our definition.

Another issue raised by certain contributors to the symposium concerns predictive research. It is clear that prediction may be a step in research and frequently is one step in research. This alone, however, does not make it a type of research. It is also clear that research may be used to investigate the grounds which render prediction possible or accurate, and research may be used to determine the correctness of prediction after it has been made. It seems questionable, however, whether the act of making a prediction itself should be considered research. We may gather truth in order to give us the basis for prediction and we may gather truth in order to verify or validate prediction. But prediction itself is not the process of gathering truth.

Another question is whether the invention of a new technique, device or method is research. As in the case of prediction, invention may be a

step in research. We frequently invent new forms of procedure, new types of apparatus, new formulas in statistics as a means of gathering together facts or organizing the facts which have been gathered. It seems hardly correct, however, to call such invention research in itself. As in the case of prediction, the establishment of the value or validity of invention may be research, because it consists in the discovery of truth concerning this particular procedure. But if our definition is correct, invention itself, like prediction, is not research.

Another question which arises in this discussion and which frequently agitates the minds of educators, is whether there is such a thing as administrative research. There certainly may be research into the problems which have a direct bearing on administration. Facts may be gathered which indicate which procedures are desirable and which are undesirable, which are efficient and which are inefficient; but the collection of such facts does not differ from the collection of other facts merely because they have a bearing upon administrative procedure. There is probably no such thing, then, as administrative research. There is research into administrative problems, but the methods of such research are not unique and do not deserve a separate classification.

THE REQUISITES OF A SATISFACTORY SCHEME OF CLASSIFICATION

Many classifications of research as well as of other matters fail because they do not observe the basic requirement of a classification. In the first place, the classes of a classification should be coördinate. That is, they should be based upon the same principle. If one class is based upon method, all the other classes of the same order should be based upon method and not upon content or aim or some other principle. The consequence of this principle is that the coördinate classes shall be mutually exclusive. A given example of research should not fall under several different classes. The very purpose of classification is violated when this happens. It is possible to have several classifications, each one based on its own principle, the different classifications being based upon different principles, but each single classification must be based on one alone.

Sub-classifications may be placed under the main heads of the basic classification, and when this is done these sub-classifications may be repeated. If the main classification, for example, is based upon methods, there may be a sub-classification under each of the main heads based upon the tools of research or upon some other basis of classification. This does not violate the principle of mutual exclusiveness since a particular

example of research would first have to be classified according to the main heads. It, therefore, would not be placed in two different subclasses.

One final comment. A classification is not the same thing as a list of steps or stages in research. It may be useful, and probably is, to indicate the stages in research, but this is not a scheme of classifying research. The scheme of classification enables us to group examples of research according to their differential marks. The series of steps represent the procedure which is followed in all examples to which this series of steps is appropriate. The order of arrangement or steps in research might conceivably form the basis of a classification if one type of research were found to proceed by one order or one series of steps, and another by another. But if these steps are considered as common to all cases of research, then the listing of the stages does not constitute a classification.

BASES OF CLASSIFICATION

If a scheme of classification is to be made out, the first step is to choose the basis for such a classification. As has been said, the same basis must be used consistently throughout a given classification. Many bases of classification have been proposed in the foregoing symposium. If all these bases are equally suitable, it will be necessary to make as many classification schemes as there are bases. It might be possible, as has been suggested, to use one basis for the main divisions and other bases for sub-classifications under these main divisions, but this procedure could not be followed very far. One or two bases of sub-classification would be as many as we could use without making the scheme prohibitively complex. We may then review the bases which have been suggested in order to determine how many of them are fundamental and how many should be considered as possible bases for classification.

Let us first consider a number of proposed bases which appear to be incidental and which do not have the importance warranting their selection as a basis of classification.

First, such a basis is the field in which the research is carried on. This refers to the subject matter, such as education or history, or it might refer to a distinction between administrative research, curriculum research, and so on. It is important to know what types of research are suitable for investigations in the various fields, but it is not necessary to dignify these distinctions by making them the basis of a classification. The classification would not be logical since there would be a good deal of overlapping between the different fields.

The second proposed basis is the place in which the research is carried on, that is, in the field or in the laboratory. This distinction, again, is not fundamental and there may be overlapping in methods between the different fields.

A third suggestion is that the classification be based upon the character of the data, as, for example, the distinction between quantitative and qualitative data. It is not certain how far this is a real distinction. It probably could be maintained that all qualitative statements could be reduced to the quantitative form. There are, of course, differences in the extent to which mathematical procedures may be used, but the use or the absence of the use of mathematical procedures is not an illuminating basis of distinction.

A fourth incidental basis is the type of symbol which is used, whether mathematical, language or other. Different types of symbols may be used in the same research and this, therefore, does not constitute a basis of distinction. A somewhat similar basis is the use of deductive or inductive thinking. Since both inductive and deductive thinking are commonly used in a given case, this does not form the basis of distinguishing between types of research. Another proposed basis which is incidental refers to the way in which the research program is organized, whether it is individual or coöperative. Since the same type of research can be carried on individually or coöperatively, this is not a fundamental basis of distinction.

We come now to a series of suggestions which approach more nearly to the definition of a fundamental basis of classification. In the first place, it is suggested that the purpose of the research be made the basis of classification, as, for example, the distinction between the purposes of description, of determination of causal relations, and of prediction. Disregarding the question of prediction, we appear to be approaching a more fundamental consideration. Description and the investigation of causal relations are two rather different procedures. There is a question, however, whether the distinction between these two procedures is not better described as a difference in method, or at least whether the distinction cannot be brought under the head of a difference in method.

Another proposed basis, namely, the way in which the factors are controlled, also obviously relates to method. The same applies to the suggestion that research be classified under the head of the methods which are used to establish a causal relationship, such as the method of agree-

ment, difference, and so on. Again, a classification based on technique of research, as, for example, historical technique, normative technique experimental technique, classification, and so on, refers obviously to method. The question is raised here as to the relation between method and technique or the distinction between method and technique. We shall have to consider this question in a moment.

The classification on the basis of devices of research, such, as statistics, questionnaire methods, calculating machines, charts, and so on refers in general to methodology but to details of methodological procedure which are of a different order from the more general methods. This, again, relates to the distinction between method, technique, and tools which will be discussed in a moment.

Other suggestions in the symposium refer specifically to method as a basis of classification. Some refer to method of procedure in conducting research and some to methods of determining the validity of procedures. The latter demands special notice. There are certain techniques for determining the validity of previously reported facts, of data gathered by observation of present events and of methods of securing conclusions or generalizations. These methods of determining validity of procedures are important, but they do not serve as the fundamental basis for discriminating between these procedures. The procedures are distinguished, in the first place, by the methods of gathering and organizing the data. The method of determining the validity of the procedure is subordinate to the method of carrying on the procedure itself.

The conclusion to which we are obviously led by this survey of proposed bases of classification is that the most fundamental basis is that of method. If different examples of research require fundamentally different methods and if these methods can be clearly set forth, method may be taken as the basic means of classifying research. The first problem to which we are brought is whether there is one method which characterizes all research, or whether there are different methods, some of which characterize certain types and others other types. The contributors to the symposium differ on this point. Some consider that there is but one basic method, some that there are various methods which can be clearly distinguished. One contributor, for example, distinguishes fifteen types of research within the field of administration alone.

There are undoubtedly certain requirements which are common to all forms of research and other requirements which are common to large classes of problems. Thus there are methods of determining the validity

of certain types of procedure, as described by Gates. Some of these methods apply particularly to the examination of records, and some to observation or the gathering of new data. This distinction corresponds to the difference between certain classes of research. It does not, however, give a complete classification. Furthermore, testing the validity of facts or observation is only part of the method of investigation. It is the critical rather than the constructive part. The third group of methods listed by Gates, namely methods of securing valid generalizations, does not distinguish between different classes of problems, but applies alike to all problems. This formulation of methods is, then, a mixture of a partial classification scheme and of principles which apply to research in general. It does not, in my opinion, constitute a satisfactory substitute for a complete scheme of classification.

Another attempt to bring all forms of research under the same description and thus to obviate the necessity of adopting a scheme of classification is to be found in Trabue's formulation. Trabue names certain attitudes which are necessary to the successful prosecution of research, and also certain special attitudes which are appropriate to the successive steps or stages in carrying through a particular piece of research. While one may agree that these attitudes do characterize the successful investigator and are common to different types of investigation, this does not necessarily mean that types of research may not be distinguished and classified on other grounds than that of attitude. Because some features are common does not mean that other features may not be different.

METHOD, TECHNIQUE, AND TOOLS OF INVESTIGATION

The previous analysis of the bases on which research may be classified has led to the conclusion that the most fundamental basis of classification is method. In attempting to work out a classification on the basis of method, confusion arises regarding the relation between method, technique, and tools of investigation. These terms are used interchangeably and no standard definition is to be found. In order that the following discussion may be clear, the terms will be used in a given specific sense. If common usage of these terms can be agreed upon it will facilitate an understanding of the issues which are involved in the classification of research.

Method will be taken to designate the general logic of the procedure in research. Method, in general, is defined by the standard dictionary as "the mode of applying logical principles to the discovery,

confirmation or elucidation of truth." Method, then, refers to the general plan upon which an investigation is organized. This plan must be worked out with reference to the nature of the problem and of the material with which the investigation is concerned. It is determined by the nature of proof or of demonstration.

Technique refers to the more specialized or detailed forms of procedure. We may distinguish general technique from special technique. General technique refers to those procedures which characterize the discovery and criticism of documentary evidence, observation, the use of tests, ratings and other measurements, work in the laboratory and the statistical and graphical manipulation of data. Under laboratory work would come the development of the plan of procedure which is appropriate for a laboratory investigations. Under statistical procedure would come planning and execution of an investigation which is carried on by statistical manipulation of data.

Special technique refers to the details of performance in an investigation, especially those requiring training and skill. Examples of such technique would be methods of observation, the use of instruments, the construction and detailed administration of tests, the detailed performance of statistical operations, the detailed methods of interpreting documents, activity and job analysis.

In addition to method and technique it is often necessary to list the tools which are to be used. Tools refer to the instruments used in gathering data or in manipulating it, such as questionnaire blanks, laboratory instruments, and calculating machines.

The distinctions which have been made will doubtless be clear with the possible exception of the distinction between method and technique. It is hoped that this distinction will become clear in the light of the suggested classification of forms of research.

A CLASSIFICATION BASED ON METHOD

Preceding a classification might be given the procedure which characterizes scientific inquiry in general. Such a description would present the steps in research, the type of thinking which is involved in research or the safeguards against error in research. Examples of such general principles have already been given.

Keeping in mind the principles which have been laid down, and selecting method as already defined for the fundamental basis of a classification, the following scheme is proposed:

A Classification of Research in Education Based on Method

1. Description

   Historical. Techniques: Discovery and criticism of documents. Survey of contemporary conditions. Techniques. Examination of records, observation, testing and measurement, statistical and graphic formulation.

   Account of genesis or development. Techniques: Observation, keeping and examination of records, testing and measurement, statistical and graphic formulation.

2. Analysis and comparison

   Analysis of particular processes. Techniques: Observation and laboratory experiment.

   Individual and group comparison. Techniques: Observation, testing or rating, statistical and graphic formulation of results.

   Case study. Techniques: Observation, keeping and examination of records, testing and synthesis of results.

3. Systematic account and explanation of relations

   Statistical analysis of relations. Techniques: techniques of gathering data in common with other methods, statistical and graphic methods of showing correlation.

   Experimental variation. Technique: Comparison of individuals or groups under controlled conditions, by the introduction of a single variable, the use of a parallel control group or the rotation of groups.

4. Forecasting (?)

   Doubt has already been expressed as to the acceptability of forecasting as a type of research.

5. Evaluation (?)

   This is what commonly goes by the name of philosophy. It is a question whether evaluation should be separated from the foregoing types of research. It should frequently stand as the culminating stage of particular investigations. Evaluation as often carried on is speculation or the expression of prejudice rather than research. It is possible, however, that one procedure may be set apart as different from the preceding and may be made the basis of further evaluation. This procedure is the synthesis of the results of a number of researches so as to apply to practical problems the facts which bear on them from many angles.

The details of such a classification as has been suggested will have to be judged after it has been tried out by applying it in detail. The writer has not yet been able to make such full and detailed application. The general outlines of the scheme are deemed justified by the analysis given in the main body of the paper. The details may require modifica-

tion or elaboration as a result of use. The value of such a classification will have to be judged by its adaptability to the uses which are described at the beginning of the paper, namely, the organization of courses for the training of research workers, and the selection of methods of research which are suitable for the investigation of various types of problems.

SUMMARY STATEMENT

1. There appears to be ample evidence in the foregoing discussion for the statement that there exists in the field of education a diversity of opinions about the classification of methods of educational research.

2. There also appears to be evidence to support the statement that there are probably many equally justifiable classifications of educational research, depending upon the point of view from which these classifications are made. The introduction of several points of view into the same classification, without explanation, is likely to lead to confusion.

3. There appears, also, to be evidence to support the statement that methods of educational research frequently acquire the names applied to them from incidental features of the research process and their applications, such as, the fields that they serve, the purposes for which they are pursued, the data gathering devices employed, etc.

4. Finally, there appears to be a larger common process, method, and purpose to which each of the so-called methods of research contributes. The ultimate goal is truth; the immediate purposes are infinitely varied, sometimes relating to status, sometimes to causes, sometimes to elements, sometimes to effects, and sometimes to prediction, in many fields of application. The process is characterized by an inductive-deductive mode of thought in which the results of human insight are verified and made generally available by an appeal to experience. The steps in this process as commonly given are: (a) recognition of a problem or felt need; (b) preliminary survey, historical, philosophical, and observational, with the purpose of increasing one's familiarity with the field, defining the problem, deriving cues, etc.; (c) the formulation of hypotheses; (d) the collection of data; (e) the analysis, classification, and interpretation of data; (f) generalization, formulation of principles, etc.; and (g) reporting of results. The process itself is further characterized by the principle of analysis, the principle of objectivity, the control of factors, and argument from likenesses and differences, employed with varying degrees of success in the various fields of applications. The various so-called methods of research are merely the means by which the thought process is facilitated, verified, and recorded.

IMPROVING OUR METHOD OF SELECTING HIGH-SCHOOL TEXTBOOKS

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Suitable textbooks are essential for effective learning by the high-school pupil. The need for better methods of selecting texts presents an important opportunity for valuable research projects.

WRONG PRACTICES IN SELECTING TEXTBOOKS

Until recently the common practice has been for the head of each school system to determine which textbooks should be used in the schools of that system. Sometimes the board of education decided this important question with little or no advice from the superintendent or teaching staff. Often school textbook salesmen sold the books to the board of education or administrator. It is frequently alleged that, in some cases, representatives of textbook companies bribed administrators and members of boards in order to have their books chosen. Such practices are so evidently wrong that they need not be discussed. We should not have textbooks sold to us but should intelligently select and buy them.

In most cases during recent years boards of education have relied upon the advice of superintendents and teaching staffs in adopting textbooks. Even under these circumstances the results have not been entirely satisfactory. Often the recommendations for adoption have been made upon the basis of incomplete knowledge or of personal whims.

The following are a few of the common unsatisfactory procedures followed in recommending textbooks for adoption.

1. A book is recommended for adoption in School A because it is advertised as being used in several large school systems in other parts of the United States. This fact does not insure that it is a good text nor that it is suited for use in School A.

2. A book is approved because of the salesmanship ability of a pleasant representative of the company publishing it.

3. Often inexperienced superintendents or teachers recommend a textbook for adoption because they are not acquainted with better ones that are available in the same field.

4. Sometimes a book is adopted because it was written by some noted university professor irrespective of the fact that he may be unfamiliar with the abilities, needs, and interests of high-school boys and girls.

5. The attractive appearance or low price of a book may exert undue influence upon boards of education or superintendents.

6. When teachers are consulted concerning the relative desirability of various textbooks submitted for consideration, they may base their recommendations upon prejudice rather than merit. If various books appear to be approximately equal in value, the teacher will probably recommend the one with which he is best acquainted in order to save himself study in mastering subject matter. Also, most teachers have special hobbies in their fields of work. If a certain text treats the field of his special interest very fully and according to his prejudices, he may recommend that book for adoption even though it may be distinctly inferior to others available when considered from all points of view.

The above are only a few of the more prominent faulty practices that have been common in adopting books as high-school texts.

BETTER BASES FOR TEXTBOOKS SELECTION

During the last decade an increasing interest in the scientific study of the qualities of textbooks resulted in a number of magazine articles on this subject. One by Judd[1] dealing with the analysis of textbooks, and another by Maxwell[2] concerning prevailing standards and justifiable standards of textbook selection were among the first. Three unsigned editorials appearing in representative magazines[3] have directed our thinking along sound lines.

A pioneer research project in vocabulary burden of textbooks[4] was carried on by Lively and Pressey. A textbook scorecard[5] was devised by Otis in 1923 which represents an attempt to make textbook measurement objective. Andrews developed a list of one-hundred items[6] which,

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[1] Judd, Chas. H. "Analyzing Textbooks," *Elementary School Journal*, XIX (October, 1918), 143-154.

[2] Maxwell, C. "The Selecting of Textbooks," *School and Society*, IX (January 2, 1919), 44-57.

[3] "Textbooks, Their Cost and Improvement," *Journal of Educational Research*, I (March, 1920), 222-224.

"What You Should Know About Textbooks," *Home, School, and Community*, XVII (February, 1925), 9-10.

"Teachers Aid in Textbook Selection," *American School Board Journal*, LXXII (June, 1926), 128.

[4] Lively, Bertha A., and Pressey, S. L. "A Method for Measuring the Vocabulary Burden or Textbooks," *Educational Administration and Supervision*, IX (October, 1923), 389-398.

[5] Otis, E. M. "A Textbook Scorecard," *Journal of Educational Research*, VII (February, 1923), 132-136.

[6] Andrews, H. "Selecting a Textbook," *American School Board Journal*, LXXII (September, 1926), 67, 152-4, 157-8.

in his opinion, should be considered in selecting a textbook. Donovan[7] discussed methods of selecting textbooks in 1924 and Johnson[8] contributed his checking list for high-school textbooks in 1925.

NEED FOR IMPROVEMENT RECOGNIZED

The importance of developing and using scientific methods of evaluating textbooks is emphasized by the growth in the number of states that have laws providing for state adoption. Twenty-nine states now have laws providing for state adoption either by the state board of education or by state textbook committees. The importance to the children of having such adoptions based upon proved merit is apparent. Moreover such state boards or committees might well secure expert service to determine the relative desirability of books submitted for consideration.

NATIONAL AND STATE TEXTBOOK RESEARCH BUREAUS NEEDED

Thoughtful consideration of the weakness of present procedures in textbook selection results in the conclusion that scientific methods of selection are imperative if effective learning is to occur. Individuals are now requested to pass judgment upon relative values of textbooks when they have had no adequate opportunities for accurate measurement. Most individuals are not specially trained for this responsibility even if they had sufficient time for scientific measurement.

The situation merits the definite organization of staffs of experts to carry out this duty under the best possible conditions. The growth of legislation providing for state-wide adoption emphasizes this need. The United States Bureau of Education might well undertake a part of this responsibility as one of its services. Such a National Textbook Research Bureau should be supplemented by state research bureaus which would study especially the adaptability of textbooks to local conditions. Such research activities should be continuous. New textbooks are being published almost daily. The measurement of such factors as adaptability to educational age, vocabulary, and interests of pupils in various grades requires time as well as favorable conditions for experimentation. The total results of various means of measurement of a textbook should be compared carefully and scientifically with others in the same field.

[7] Donovan, H. L. "How to Select Textbooks," *Peabody Journal of Education*, II (July, 1924), 1-11.

[8] Johnson, F. W. "Checking List for High-School Textbooks," *Teachers College Record*, October, 1925.

MAJOR FIELDS FOR RESEARCH IN IMPROVING TEXTBOOK SELECTION

The following are important factors which should be considered in textbook selection. They are, likewise, suitable subjects for research activities.

1. Training and educational experience of the authors.
2. The accuracy of subject matter.
3. The organization, balance, and emphasis of subject matter.
4. Suitability of text material to the psychological and educational development of the pupil in the grade considered.
5. Suitability and amount of illustration.
6. Style of writing from viewpoint of suitability for pupil.
7. Vocabulary burden suited to pupil.
8. Interest for pupils for whom intended.
9. Mechanical features of printing and binding.
10. Costs.

INVESTIGATIONS ALREADY COMPLETED

The progress being made by individuals points to the possibilities of service which might be given by National and State bureaus. The leading studies in this field have been made by Lively and Pressey,[9] Woodburn,[10] Ward,[11] Housh,[12] Dolch,[13] and Remmers and Grant.[14]

COMPREHENSION DIFFICULTIES MALADJUSTED

Much has been said concerning the comparative difficulty of each year of high school. Many teachers have held the opinion that the first two years of high school were more difficult than the succeeding years. Similarly, we often hear the statement from pupils who have just completed their high-school course, or who are in the last year of it, that

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[9] Lively, Bertha A., and Pressey, S. L. "A Method for Measuring the Vocabulary Burden of Textbooks," *Educational Administration and Supervision*, IX (October, 1923), 389-98.

[10] Woodburn, Thelma V. "A Study of the Vocabulary of Wells' and Hart's Algebra with a view to Determination of Its Difficulty for the Average Ninth Grader," *Master's Thesis*, Indiana University, 1927.

[11] Ward, J. L. "Measuring Vocabulary Burden," *American School Board Journal*, LXXI, p. 98.

[12] Housh, E. T. "Analysis of the Vocabularies of Ten Second Readers," *Seventeenth Yearbook of National Society for Study of Education*, Part II, p. 40.

[13] Dolch, Edward W. "Vocabulary Burden," *Journal of Educational Research*, XVII (March, 1928), 170.

[14] Remmers, H. H., and Grant, A. "The Vocabulary Load of Certain Secondary School Mathematics Texts," *Journal of Educational Research*, XVIII (October, 1928), 203.

their junior and senior years were not as difficult for them as were the other two years.

It seems only logical that, from the point of administration of secondary schools, the courses should be arranged so that there would be, approximately at least, a definite ratio of increase in the difficulty of work throughout the school life of the individual. Such an organization should greatly facilitate the educational development of the pupil. Therefore, it will be valuable to the school administrator to know the relative difficulty of each subject offered within his curricula in order that, in forming his course of study, they may be so arranged as to afford this definite rate of progress. In this way he may greatly eliminate the withdrawal of pupils from school for internal causes.

VOCABULARY BURDEN AN INDEX TO LEARNING DIFFICULTY

With these things in mind, we made a study in which we attempted to measure the vocabulary burden of each of the Indiana State adopted texts which are written in the English language. It seems evident that the ease of reading and understanding any material is one index to its difficulty; consequently the difficulty of the vocabulary is an important contributing or detracting factor to learning. In addition to the difficulty of the vocabulary, its bulk is also a determining factor in measuring the reading burden of any particular text.

To accomplish this task, we set up a definite technique, which will be explained in the next month's issue of this magazine, and applied it to each text. Then, for the benefit of the administrator, we, through a questionnaire, endeavored to determine the proportional use of each text in each year of high school throughout the state of Indiana. This technique enabled us to develop an index number for each text and for each year of high school the size of which varies inversely with the reading burden.

TEXTS DIFFER IN VOCABULARY BURDEN

For the convenience of the reader the formula for finding the index number for each text is presented here.

I.N. = A.W.W.V. divided by R., where I.N. is the index number, A.W.W.V. is an average-word-weighted-value, and R. is the range of the words. A.W.W.V. is found by the formula, $\text{A.W.W.V.} = \frac{\text{T.W.V.}}{\text{T.W.S.}}$, where T.W.V. is the total of the weighted values, and T.W.S. the total words in the sample.[15]

[15] A detailed discussion of the development of this technique will appear in next month's issue of this magazine.

TABLE 1

TEXTBOOK LIST SHOWING FREQUENCY OF USE IN SEVENTY REPRESENTATIVE INDIANA HIGH SCHOOLS AND INDEX NUMBERS AS DETERMINED ON FORMER TABLES

Names of Texts	Year Offered 1	2	3	4	Index Number
Our English, Denny & Skinner	63	1	2		.464
Written and Spoken English, Clippenger	4	68	35	11	.238
English Literature, Long			17	10	.238
Outlines of Eng. Lit., Long			36	5	.303
Outlines of Eng. Lit. Readings, Long			10	5	.341
American Literature, Long			3	11	.278
Outlines of American Lit., Long		1	1	32	.486
Outlines of Am. Lit. Readings, Long		1	2	10	.439
Early European History, Rev., Webster	3	3	1		.169
Modern European History, Rev., Webster		4	1		.381
Modern Times and Living Past, Elson		65	4	1	.193
History of the United States, Beard		4	59	9	.201
Government in the U. S., Smith, etc	1		11	54	.208
El. Prin. of Chemistry, Brownlee, etc			2	5	.275
First Book in Chem. (1928 Ed.) Bradbury			5	3	.130
Chemistry and Its Uses, McPherson, etc			1	3	.370
Beginning Chem. and Its Uses, Irwin, etc				1	.267
El. Prin. of Physics, Fuller, etc			3	8	.210
Elements of Physics, Millikan and Gale			11	32	.309
Essentials of Modern Physics, Dull			1	3	.338
Physics in Everyday Life, Henderson			5	9	.278
Commerce and Industry, Smith		5	7	6	.216
High-School Geography, Whitbeck	5	8	9	8	.247
First Course in Algebra, Nyberg	63	12	2		.450
Second Course in Algebra, Nyberg		24	31	5	.593
Modern Plane Geometry, Clark & Otis		50	22	5	.512
Modern Solid Geometry, Clark & Otis		1	27	15	1.472
Arithmetic of Business, Smith	14	7	9	21	.359
Applied Arithmetic, Smith	4	3	4	4	.466
Farm Projects and Problems, Davis	4		1	2	.278
Animal Husbandry, Harper	3	2	1	1	.259
Soils and Crops, Mosier	4	4	1		.285
Studies in Horticulture, Lloyd	1	1			.357
Engineering on the Farm, Stewart	1	1	1		.336
Practical Botany (Agri.), Bergen, etc	4	1	2	2	.273
Plant Life and Plant Uses, Coulter					.295
El. Studies in Botany, Coulter	2		1	1	.346
First Course in Botany, Pool & Evans	4		4	1	.306
Textbook in Botany, Allen, etc				1	.400
Animal Studies, Jordon, etc	1	1			.294
General Zoology, Linville, etc	1	1	2	2	.315
Healthful Living, (Rev.), Williams	9		4	7	.262
Practical Zoology, Hegner					.310
Total Number of Frequencies for each Year Equals *N* or.	184	268	338	293	

TABLE II

TABLE SHOWING FREQUENCY INDEX PRODUCTS AND THE AVERAGE INDEX NUMBERS FOR EACH YEAR

Names of Texts	Frequency Index Products 1 yr.	2 yr.	3 yr.	4 yr
Our English, Denny & Skinner	29.484	.464	.928	
Written and Spoken Eng., Clippenger	.952	16.184	8.330	2.618
English Literature, Long			4.046	2.380
Out. of Eng. Lit., Long			10.908	1.515
Out. of Eng. Lit. Readings, Long			3.410	1.705
American Literature, Long			.834	3.058
Out. of Am. Lit., Long		.486	.486	15.552
Out. of Am. Lit. Readings, Long		.439	.878	4.390
Early European Hist., Webster	.507	.507	.169	
Mod. European Hist., Webster		1.524	.381	
Modern Times and Living Past, Elson		12.654	.772	.193
History of U. S., Beard		.804	11.859	1.809
Gov. in the U. S., Smith, etc	.208		2.288	21.232
El. Prin. of Chem., Brownlee, etc			.550	1.375
First Book in Chem., Bradbury			.650	.390
Chem. and Its Uses, McPherson, etc			.370	1.110
Beginning Chem. and Its Uses, Irwin, etc				.267
El. Prin. of Physics, Fuller, etc			.630	1.680
El. of Physics, Millikan & Gale			3.399	9.888
Essentials of Mod. Physics, Dull			.338	1.014
Physics in Everyday Life, Henderson			1.390	2.512
Commerce and Industry, Smith		1.080	1.512	1.296
H. S. Geography, Whitbeck	1.235	1.936	2.223	1.936
First Course in Algebra, Nyberg	28.350	5.400	.900	
Sec. Course in Alg., Nyberg		14.232	18.383	2.965
Modern Plane Geom., Clark & Otis		25.600	11.264	2.560
Mod. Solid Geom., Clark & Otis		1.472	40.544	22.080
Arith. of Business, Smith	5.026	2.513	3.231	7.539
Applied Arithmetic, Smith	1.864	1.398	1.864	1.864
Farm Projects and Problems, Davis	1.112		.278	.556
Animal Husbandry, Harper	.777	.518	.259	.259
Soils and Crops, Mosier	1.140	1.140	.285	
Studies in Horticulture, Lloyd	.357	.357		
Engineering on the Farm, Stewart	.336	.336	.336	
Practical Bot. (Agri.) Bergen, etc	1.092	.273	.546	.546
Plant Life and Plant Uses, Bergen, etc				
El. Studies in Bot., Coulter	.692		.346	.346
First Course in Bot., Pool & Evans	1.224		.924	.306
Textbook in Bot., Allen, etc				.400
Animal Studies, Jordon, etc	.294	.294		
General Zoology, Linville, etc	.315	.315	.630	.630
Healthful Living, Williams	.524		1.048	1.834
Practical Zoology, Hegner				
Total Frequency-Index-Products for Each year	75.489	89.917	137.189	117.805
Average Index Number of Texts Used in Each Year	.410	.3555	.406	.402

From Table I, we see that Bradbury's *First Book in Chemistry* has the greatest vocabulary burden, the index number being only .130, while the book having the lightest vocabulary burden is Clark and Otis's *Modern Solid Geometry* with an index number of 1.472. With the exception of the last named book, all the rest have index numbers under .600, while the greater percent of the index numbers fall between .200 and .400.

TENTH YEAR HAS HEAVIEST LOAD

In totaling the frequencies of the use of State adopted texts in each year of high school, we find that, in the seventy coöperating schools, state adopted texts were used one hundred eighty-four times in the freshman year, two hundred sixty-eight times in the sophomore year, three hundred thirty-eight times in the junior and two hundred ninety-three times in the senior year. By using the formula for finding the mean, $M = \frac{\Sigma fX}{N}$, in which Σ represents the sum of, f is the frequency of the use of a text in any one year of school, X is the index number for each text, and N is the total number of frequencies of the use of all state adopted texts for that year, we obtained an average index number of the Indiana state adopted texts as used in each year of high school. The values for fX, the ΣfX, and the average index numbers are shown in Table II. These average index numbers are .410 for the first year, .336 for the second year, .406 for the third year, and .402 for the fourth year of high school.

CHART I

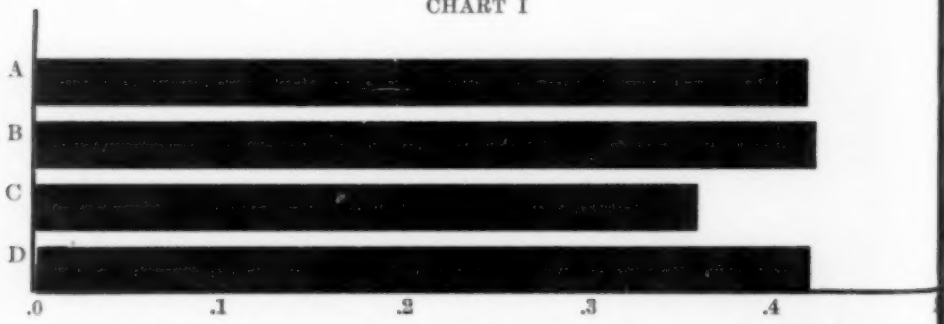

Chart showing the average Index Numbers for each year of high school. This represents, inversely, the vocabulary burden of each year—the shorter the line, the heavier the burden.

A. Senior Average Index Number..... .402
B. Junior Average Index Number..... .406
C. Sophomore Average Index Number..... .3555
D. Freshman Average Index Number..... .410

From these results we would draw the conclusion that the sophomore year of high school has the greatest vocabulary burden, and that there is little difference between the freshmen, junior, and senior years. The difference in the frequencies of use of state adopted books may be accounted for by the fact that in those years having the lesser frequencies there are fewer electives offered and, in some of the courses offered, there are no state adopted texts, each school corporation being free to choose from a suggested list. We can only assume, in the latter case, that the texts used, probably on the average, compare favorably with the state adopted texts used in that particular year insofar as vocabulary burden is concerned.

SUMMARY OF FINDINGS

We have found the following things pointed out in this study:

1. Science is offered more often in the last two years of high school than it is in the first two.

2. Bradbury's *First Book in Chemistry* has the heaviest vocabulary burden of all the texts studied, having an index number of only 1.130.

3. Of all of the science texts, Physics and Chemistry texts seem to have the heaviest vocabulary burden.

4. Although Allen and Gilbert's *Textbook in Botany* seems to have the lightest vocabulary burden of all of the science texts, the frequency of its use is the least.

5. In English, the most commonly used senior text has a lighter vocabulary burden than the most commonly used freshman text.

6. The vocabulary burden of sophomore English is the heaviest of the four years English work, being followed in rank order by the junior, freshman, and senior years.

7. In the Social Studies, the texts used most commonly in the junior and senior years have the lightest vocabulary burdens.

8. Junior mathematics is the easiest insofar as vocabulary burden is concerned, and is followed in rank order by the sophomore, freshman, and senior years.

9. Clark and Otis's *Modern Solid Geometry* has the shortest vocabulary of all of the Indiana state adopted texts.

10. In the case of the agriculture texts, we find the only example of an appearance of gradation of vocabulary burden, for those having the lightest burden are not offered in the junior and seniors years. This must be purely accidental, however, for the texts having the heaviest

vocabulary burden are used more times in the first year than in any other year of high school.

11. Agriculture is offered more often in the first and second years of high school than it is in the latter years.

12. Finally, the total vocabulary burden of the sophomore year seems to be far greater than that of any other year, while there is very little difference between the vocabulary burdens of the freshman, junior, and senior years.

FIELDS AND TYPES OF RESEARCH IN EDUCATION, 1918-1931 *

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Contribution of Educational Research.—It is relatively easy to see the contribution of research to such fields as medicine and invention. It is more difficult, however, to determine objectively the results of research in education, which is concerned with the mental and educational development of youth. It is readily recognized that discoveries of serums, antitoxins, surgical methods, etc., in medicine mean the saving of almost countless human lives. There are equal possibilities for the development of new methods of teaching and of school administration which will promote the educational development of children. No one can calculate to what extent the mental lives of large numbers of children have been blighted and stunted by poor teaching and administrative procedures.

Swift gives an interesting example of the contribution of educational research.[1] A graduate of a western university went to a small town as school superintendent. One morning a distraught mother came to him with the story that the local physician had pronounced her three-year-old boy feeble-minded and had suggested that he be sent to a feeble-minded institution. The chief reason for this diagnosis was that at the age of three he had not yet learned to talk. The school superintendent suggested that the child be sent to the psychological clinic of the state university. This was done. After a careful examination the psychologist at the clinic told the mother that instead of being a feeble-minded child, her son was above average intelligence. She was advised to allow the boy to play with other children as usual and that in due time he would learn to talk. This was done, and in the course of time the child learned to talk, and later surpassed other children of the same age in his vocabulary and general attainment. Imagine what might have happened without the aid of a professionally trained school superintendent and without the facilities of a psychological clinic.

Locating Research in Education.—There are three major types of educational literature, classified in terms of form in which it appears:

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* Read before Section Q of the American Association for the Advancement of Science at Cleveland, December 29, 1930.

[1] Swift, F. H. "The Increasing Professionalization of Educational Workers," *School and Society*, XXXII (October 11, 1930), 480-84.

(1) graduate theses (usually typewritten); (2) monographs, books, yearbooks, bulletins, and other published materials in bound form; and (3) articles in periodicals.

The annual or biennial lists of graduate theses in education issued by the University of Illinois for the period 1917-1927, and the annual bibliographies of research in education, especially since 1927, prepared by the United States Office of Education, enable one to locate readily the titles of completed Masters' and Doctors' theses. Monroe's *Ten Years of Educational Research, 1918-1927*, includes the titles of Doctors' theses prepared during the decade covered.[2]

This same volume and Monroe's *Locating Educational Information in Published Sources*[3] are excellent basic bibliographies for locating materials of the second type mentioned above. The canvass of books, monographs, etc., may be brought up to date by examining the annual list of educational books, which appears during the last week of the year in *School and Society*. The list of sixty educational books of the year, that is published in the March or April number of the *Journal of the National Education Association*, is chosen annually from the total yearly output of more than six hundred titles in education.

Magazine articles may be located in the several periodical indexes and educational abstracts: the new *Education Index, Loyola Educational Index* (1928 only), *Readers' Guide to Periodical Literature, International Index to Periodicals, Teachers Journal and Abstract, Loyola Digest*, and the new abstract and summary periodical of the American Educational Research Association, and *Review of Educational Research*. The annual bibliographies of the Office of Education, some of which have dealt specifically with secondary education, also are useful in canvassing all types of educational publications.

These indexes, bibliographies, abstracts, and summaries have been made necessary by the rapid increase in educational literature during the past decade. In fact, workers in certain fields have assumed responsibility for publishing summaries at regular intervals: Gray in reading,

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[2] Monroe, W. S., and others. *Ten Years of Educational Research, 1918-1927*. University of Illinois Bulletin, Vol. XXV, No. 51. (Urbana, Illinois: University of Illinois, 1928), 368 pp.

[3] Monroe, W. S., and others. *Locating Educational Information in Published Sources*. University of Illinois Bulletin, Vol. XXVII, No. 45. (Urbana, Illinois: University of Illinois, 1930), 142 pp.

Buswell in arithmetic, Lyman in language, grammar, and composition, Curtis in science, Blackstone in commercial education, and Watson in religious education. Critical summaries require research ability of high order and are among the most valuable contributions to educational literature.

Techniques of Research. — There are numerous classifications of methods of collecting data. Symonds suggests that all research is statistical in that generalization requires more than one case.[4] Almack discusses techniques of investigation under the headings of historical, experimental, and normative methods.[5] Monroe gives illustrations of subjective, analytical, experimental, historical, interview, legal, questionnaire, survey, test-construction, and observation techniques.[6] Crawford's classification includes: experimental, historical, psychological, case study, survey, curriculum-making, job analysis, interview, questionnaire, observation, measurement, statistical, tabular and graphic, and library techniques.[7] Waples and Tyler discuss techniques of analysis, reading and recording, observation, personal interview and group conference, obtaining written statements by question blanks, check list, sampling, classification, summarizing, evaluation, individual judgment, group rating, comparison, space and frequency counts, testing, and experimentation.[8] Koos' classification is: questionnaire, experiment, measurement, documentary analysis, case, mathematics, and survey.[9]

For the purpose of this discussion a working classification of the various techniques or methods of collecting educational data may be organized under eight headings.[10] It is recognized that the various procedures

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[4] Symonds, P. M. "A Course in the Technique of Educational Research," *Teachers College Record,* XXIX (October, 1927), 24-30.

[5] Almack, J. C. *Research and Thesis Writing.* (Boston: Houghton Mifflin Co., 1930), pp. XVIII + 310.

[6] Monroe, W. S., and Engelhart, M. D. *The Techniques of Educational Research,* University of Illinois Bulletin, Vol. XXV, No. 19. (Urbana, Illinois: University of Illinois, 1928), pp. 28-38.

[7] Crawford, C. C. *The Technique of Research in Education.* (Los Angeles, California: University of Southern California, 1928), 320 pp.

[8] Waples, Douglas, and Tyler, R. W. *Research Methods and Teachers' Problems.* (New York: Macmillan Co., 1930), Chapter VI.

[9] Koos, L. V. *The Questionnaire in Education.* (New York: Macmillan Co., 1928), pp. VIII + 178.

[10] Good, Carter V. *How to Do Research in Education.* (Baltimore: Warwick and York, 1929), Chapter VI.

differ in value as research techniques and that some are basic methods, while others are tools or devices.

1. Philosophical, subjective, and committee judgment.
2. Historical, legal, bibliographical, and summary.
3. Survey, comparative, and descriptive.
4. Questionnaire, check list, rating scale, correspondence, and interview.
5. Statistical, mathematical, testing, and test construction.
6. Experimental, laboratory, and controlled observation.
7. Case study, case group, and genetic.
8. Analysis (activity, job, social need or usage, books, courses of study, difficulties, etc.).

Doctors' Theses Classified by Fields.—Doctors' dissertations are a good indication of types, fields, and trends in research. Table I is a classification by fields of 1,359 Doctors' theses completed in education from 1918 to 1929 and of 587 theses under way, 1930-1931. The titles in Monroe's *Ten Years of Educational Research*, 1918-1927, and in the bulletins of educational research for 1927-1928 and 1928-1929 of the Office of Education were scanned in making this tabulation.[11] The titles [12] of the Doctors' theses under way in education were collected from twenty-six graduate schools in December, 1930. It is recognized that in some cases a given title can be placed under more than one heading. Consequently an effort was made to classify the thesis according to each major field represented in the title. Since one person did the classification the procedure employed was uniform and should be accurate enough to indicate roughly trends of interest in the preparation of theses.[13]

In view of the fact that many graduate students have been, and are, school administrators and supervisors, it is not surprising that a large number of theses completed and under way are in the field of administration and supervision. A comparison of the total number of completed

[11] Monroe, W. S., and others. *Op. cit.* Wright, Edith A. ***Bibliography of Research Studies in Education.*** 1927-1928. Office of Education Bulletin No. 36. (Washington: Office of Education, 1929), pp. X + 226. Wright, Edith A. ***Bibliography of Research Studies in Education.*** 1928-1929. Office of Education Bulletin No. 23, 1930. (Washington: Office of Education), pp. X +308.

[12] Good, Carter V. "Doctors' Theses Under Way in Education, 1930-1931," *Journal of Educational Research*, XXIII (January, 1931), pp. 85-112. The schools represented are: Boston, California, Catholic University, Columbia, Cornell, George Washington, Harvard, Illinois, Indiana, Iowa, Johns Hopkins, Kansas, Michigan, Missouri, New York, Ohio, Oregon, Peabody, Pennsylvania, Pittsburgh, Southern California, Stanford, Texas, Washington, Wisconsin, and Yale.

[13] Part of the computations reported were made by J. A. Woofter, graduate student, University of Cincinnati.

theses in psychology and measurement with those under way indicates a relative decrease in this field; this may be a natural reaction to the over-emphasis on tests and measurements during the decade following the war period. It is to be expected that an investigator in the field of method will conduct his study in a given school subject, which explains the large number of theses under the heading, "special subjects," as compared with the smaller number under "general method and theory." One is impressed by the total absence of Doctors' theses under way in art education and by the small numbers in certain other school subjects: commercial education, 3; foreign languages, 3; home economics, 7; manual, industrial, and agricultural arts, 11; and music, 4. The number of theses under way in other school-subject fields is as follows: English, reading, and language, 39; mathematics and arithmetic, 34; moral, religious, and character education, 48; physical and health education, 21; science, 30; and social studies, 22. The current interest in problems of moral, religious, and character education is evidenced by the comparatively large number of studies under way in this field. This number is large, however, in part, because of the fact that certain schools of education classify theses in religious education under the heading of education. There is a decrease in the number of theses dealing with philosophical or subjective aspects of educational theory. In the history of education and foreign education, during the earlier years, a large proportion of the theses dealt with educational history in the United States; during the past few years, with the influx of an increasing number of foreign students, systems of education in other countries are being studied. The International Institute of Teachers College, Columbia University, has been especially active in this field. Pre-school and elementary education as a field for research has not received adequate attention in Doctors' dissertations, although a marked increase in number of theses in this field is noted in 1927, 1928, and 1929. Possibly the fact that a large number of elementary-school workers have not felt the urge to secure a Doctor's degree explains the relatively small number of studies in this field. Secondary education receives a fair proportion of attention. Since 1924 a decided increase in the number of dissertations in higher education is noted. Nearly one-third of the theses under way deal with problems of higher or adult education.

Table II is a classification by fields and years of the Doctors' studies completed and under way in secondary education. Administration and supervision and the secondary-school subjects receive most attention.

The history of secondary education and comparative secondary education might well be investigated more frequently; it will be noted that the number of studies under way in this field represents a relative increase.

Use of Historical and Legal Techniques.—It is often said that the history of education and utilization of the historical method of research have been neglected. Table III shows, insofar as can be determined from an examination of the titles of theses, to what extent historical or legal techniques of research have been used. The facts revealed show that approximately one-ninth of all Doctors' theses completed and under way involve either the historical or legal technique of investigation. It should be stated, however, that during the past few years the legal rather than the historical thesis has been in favor. The fields which seem, on the basis of frequency, most in need of historical studies are psychology and measurement and elementary education.

Techniques of Research in the Teachers College Contributions to Education.—The Teachers College (Columbia) Doctors' theses, as the largest collection available and the most easily accessible, were scanned rapidly to ascertain the various techniques employed. Of course, many theses involve more than one method of collecting data and are classified accordingly. Table IV and Table V include the results of this analysis of 397 available dissertations, with an average of approximately two techniques for each study. Evidently the purely philosophical or subjective thesis is infrequent and is becoming increasingly so. The historical and legal methods are a fair proportion of the total, although not employed frequently in secondary education. The former interest in philosophical, theoretical, and historical problems has shifted to legal and foreign aspects of education, although the technique involved is much the same. The questionnaire-correspondence method has been used in half of the Doctors' dissertations printed in this series since 1924. This seems an overworking of a useful device especially in secondary education. Students seem to recognize the criticism that attaches to indiscriminate use of the questionnaire and seek to avoid the term by substituting such labels as question forms, data sheets, research blanks, and history blanks. Naturally statistical procedures have been employed in a majority of the theses. More experimental studies are needed, especially in secondary education. This is a type of research little used before 1920 in this series of dissertations, and apparently not at all in secondary education before 1920. There are real possibilities in wider use of the case method which is

TABLE I

CLASSIFICATION OF 1359 DOCTORS' THESES IN EDUCATION COMPLETED, 1918-1929, AND OF 587 DOCTORS' THESES UNDER WAY, 1930-1931

FIELD	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1918-29 Total	Und. Way 30-31	Gr. Total
Administration and Supervision	20	13	13	17	19	29	27	42	62	62	60	46	410	165	575
Psychology and Measurement (General)	9	14	19	11	30	29	31	39	41	51	52	54	380	108	488
General Method and Theory	3	8	8	6	4	8	13	13	17	17	11	11	119	40	159
History of Education and Foreign Education	14	10	10	5	10	18	15	18	23	23	25	16	187	92	279
Pre-School and Elementary Education	3	4	5	5	5	3	7	8	5	14	25	24	108	52	160
Secondary Education	8	10	5	8	3	16	18	22	27	30	35	29	211	86	297
Higher Education and Adult Education	3	3	6	2	11	10	14	26	37	49	43	40	244	181	425
School Subjects	9	11	16	12	14	25	30	29	50	43	66	78	383	222	605
Total Theses	53	50	61	43	68	94	110	137	181	189	194*	179*	1359**	587**	1946**

* Titles probably are not completely listed for 1928 and 1929 in the Office of Education bulletins.

** This, the total number of theses, is less than the total times the various fields are represented, since a given thesis may be classified under more than one subdivision of education.

recent in its application to education. Within the past five years the technique of analysis (activities, textbooks, difficulties, etc.) has been applied more frequently than before. In certain instances, however, this method proves to be a mechanical tabulation of frequency counts hardly in keeping with the sort of problem-solving contribution expected of the Doctor's candidate. A number of graduate students participated in school surveys between 1925 and 1929 and used portions of the data accumulated as Doctors' dissertations. Valuable field experience may be secured in this way.

Other Analyses of Techniques of Research. — Classifications of the techniques of research employed in 581 studies and in one hundred Doctors' theses are reported respectively by Koos [14] and Bixler,[15] although the factor of selectivity makes impossible valid comparisons of frequencies between their results and the classification reported in Table IV. Douglass presents a significant analysis of types and fields of secondary curriculum research during 1929.[16]

Coöperative Research.—A movement of major importance in education is evidenced by an increasing number of coöperative and large-scale studies of national scope, made possible by large subsidies and the leadership of able educational workers and professional groups. The highly significant educational yearbooks of the past few years have been made possible by means of such coöperation and industry. The work of the United States Office of Education, the Research Division of the National Education Association, foundations, and of city, state, and university bureaus of educational research provides illustrations of this method of organizing and administering research.

Specific examples of coöperative research may be cited by naming a dozen educational investigations, experiments, or series of studies of unusual significance which have been carried forward within the past decade. Among these contributions are: the Minnesota experiments in higher education; the nature and nurture yearbook of the National Society for the Study of Education; the sixteen studies of the Committee

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[14] Koos, L. V. *The Questionnaire in Education.* (New York: Macmillan Co., 1928), p. 37.

[15] Bixler, H. H. *Check Lists for Educational Research.* (New York: Bureau of Publications, Teachers College, Columbia University, 1928), p. 85.

[16] Douglass, Harl R. "Types and Fields of Curriculum Research in Secondary Education," *School Review,* XXXVIII (November, 1930), 656-62.

TABLE II

CLASSIFICATION OF 211 DOCTORS' THESES IN SECONDARY EDUCATION COMPLETED, 1918-1929, AND OF EIGHTY-SIX DOCTORS' THESES UNDER WAY, 1930-1931

FIELD	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1918-29 Total	Und. Way 30-31	Gr. Total
Administration, Supervision and Teacher Training	3	6	3	2	1	4	6	13	14	15	11	10	88	37	125
Psychology and Measurement (General)	1	1	1	2	1	4	2	2	5	2	5	1	27	11	38
General Method and Theory	0	0	1	1	0	2	0	1	1	1	0	1	8	2	10
History of Education and Foreign Education	3	1	1	0	1	0	1	2	1	2	5	1	18	13	31
School Subjects	1	4	1	3	0	7	9	6	7	9	16	15	78	35	113
Total Theses	8	10	5	8	3	16	18	22	27	30	35	29	211*	86*	297*

* This, the total number of theses, is slightly less than the total times the various fields are represented, since a given thesis may be classified under more than one subdivision of secondary education.

TABLE III

CLASSIFICATION OF 151 DOCTORS' THESES IN EDUCATION COMPLETED, 1918-1929, AND OF SEVENTY-TWO DOCTORS' THESES UNDER WAY 1930-1931, EMPLOYING HISTORICAL OR LEGAL TECHNIQUES

FIELD	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1918-29 Total	Und. Way 30-31	Gr. Total
Administration and Supervision	2	2	1	1	1	4	2	5	4	7	6	6	41	19	60
Psychology and Measurement (General)	0	0	1	0	0	0	1	0	0	1	0	0	3	1	4
General Method and Theory	1	2	1	0	0	1	1	2	3	7	0	0	18	9	27
History of Education and Foreign Education	13	8	7	3	7	12	10	14	15	22	17	19	147	53	200
Pre-School and Elementary Education	0	0	0	1	0	0	0	1	1	0	1	1	5	1	6
Secondary Education	3	1	0	0	1	1	1	2	1	3	2	2	17	10	27
Higher Education and Adult Education	1	1	1	0	1	2	2	0	3	4	3	0	18	11	29
School Subjects	1	0	1	2	2	2	2	3	6	3	3	4	29	3	32
Total Theses	13	8	6	4	8	13	10	16	21	23	18	11	151*	72*	223*

* This, the total number of historical theses, is less than the total times the various fields are represented, since a given thesis may be classified under more than one subdivision of education.

on Administrative Units of the Commonwealth Fund; the seventeen volumes of the Modern Foreign Language Study; the Classical Investigation; the six investigations of adult learning sponsored by the American Association for Adult Education; the Chicago reading and eye-movement studies; the three Stanford *Genetic Studies of Genius;* the thirteen volumes of the Educational Finance Inquiry; the *Commonwealth Teacher-Training Study* and other major applications of the technique of job analysis; the three studies of the Character Education Inquiry; and Thorndike's investigations of the measurement of intelligence and adult learning. The national surveys of secondary education, teacher training, and the social studies should be added, although they are not yet completed. In these series of studies may be found numerous examples of each of the techniques of educational research previously discussed.

It is a safe prediction that such coöperative investigations will continue to break down academic isolation in research, to prevent unneces-

TABLE IV

CLASSIFICATION OF TECHNIQUES OF RESEARCH IN 397 TEACHERS COLLEGE (COLUMBIA) CONTRIBUTIONS TO EDUCATION

	—Period—						Total times
TECHNIQUE	1905 1909	1910 1914	1915 1919	1920 1924	1925 1929	1930	technique used
Philosophical	6	5	0	3	7	0	21
Historical, legal	17	17	8	13	44	2	101
Questionnaire	4	6	5	11	101	28	155
Statistical	10	20	25	49	196	41	341
Experimental	1	3	4	14	36	8	66
Case	0	0	0	4	3	2	9
School Survey	0	1	2	0	14	0	17
Analysis	1	1	4	7	30	13	56
Total Theses	23	31	29	57	213	44	397*

* This, the total number of theses, is less than the total number of times the various techniques were used.

TABLE V

CLASSIFICATION OF TECHNIQUES OF RESEARCH IN SIXTY-SEVEN TEACHERS COLLEGE (COLUMBIA) CONTRIBUTIONS TO SECONDARY EDUCATION

	—Period—						Total times
TECHNIQUE	1905 1909	1910 1914	1915 1919	1920 1924	1925 1929	1930	technique used
Philosophical	0	0	0	0	0	0	0
Historical, legal	1	1	0	2	5	0	9
Questionnaire	0	1	2	1	22	6	32
Statistical	1	3	6	10	36	9	65
Experimental	0	0	0	4	7	2	13
Case	0	0	0	1	1	1	3
School Survey	0	0	1	0	2	0	3
Analysis	1	0	0	2	7	2	12
Total Theses	2	3	6	11	36	9	67*

* These are part of the 397 theses classified in Table IV; the total is less than the total number of times the various techniques were used.

sary duplication of effort, and to collect and make available valuable information to educational workers. Secondary education has a generous share in large-scale investigations and may well promote nation-wide studies in other subject-matter fields similar to the Modern Foreign Language Study. In fact it has already been suggested [17] that workers in the field of English are now in a better position to launch a comprehensive investigation than were the modern-language people at the time their study was started. A nation-wide survey of school finance has been authorized. Whatever the future may hold in the way of coöperative research, there is encouragement for the present in the progress made in modern foreign language, Latin, mathematics, the social studies, and in the national surveys of secondary education and teacher training.

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[17] Leonard, S. A. "Research in the Teaching of English," *Journal of Educational Research*, XIX (March, 1929), 317-21.

SIMPLIFIED METHODS FOR COMPUTING REGRESSION COEFFICIENTS AND MULTIPLE AND PARTIAL CORRELATIONS

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IN a previous article in this journal we discussed the nature and the use of the multiple regression equation, and set up work sheets for computing regression coefficients by the Doolittle Method. For any large number of variables the Doolittle Method is easily the best method available. But it is somewhat baffling to a novice and it does not lend itself well to the calculation of partial correlations. In this article we shall set up work sheets for an alternative method that is easier for novices to use and that is especially convenient for the calculation of partial correlations. But its use is limited to problems not exceeding five variables; beyond that point it becomes too cumbersome and should be replaced by the Doolittle Method.

A regression coefficient, it will be remembered, is an index of "best weight" by which a set of scores should be multiplied if they are to be given the weight to which their relative importance entitles them in making up, or in predicting, a criterion of which they, along with other scores, are constitutents. The problem involved in working with regression equations is to find, from a set of basic "normal equations," the values for the several optimum weights—the regression coefficients—which we have designated in the regression equations as B's.

A calculus development in our previous article gave the following as the set of normal equations. We need solve these for the several B's. In order to bring out the symmetry of these equations, and to make them more easily remembered, we are inserting r_{11}, r_{22}, etc., although these are always equal to 1. In actual work we substitute a 1 for each of these perfect self-correlations. We are also, in order to bring out the symmetry, writing some subscripts in an unconventional order. The conventional form is to place the smaller subscript first, r_{12} instead of r_{21}. But the two ways of writing the symbol mean precisely the same thing.

$$r_{01} = B_1r_{11}+B_2r_{12}+B_3r_{13}+B_4r_{14}+B_5r_{15}+\ldots\ldots\ldots\ldots+B_nr_{1n}$$
$$r_{02} = B_1r_{21}+B_2r_{22}+B_3r_{23}+B_4r_{24}+B_5r_{25}+\ldots\ldots\ldots\ldots+B_nr_{2n}$$
$$r_{03} = B_1r_{31}+B_2r_{32}+B_3r_{33}+B_4r_{34}+B_5r_{35}+\ldots\ldots\ldots\ldots+B_nr_{3n}$$
$$r_{04} = B_1r_{41}+B_2r_{42}+B_3r_{43}+B_4r_{44}+B_5r_{45}+\ldots\ldots\ldots\ldots+B_nr_{4n}$$
$$r_{0n} = B_1r_{n1}+B_2r_{n2}+B_3r_{n3}+B_4r_{n4}+B_5r_{n5}+\ldots\ldots\ldots\ldots+B_nr_{nn}$$

A good method of handling such a set of equations as the above is by determinants. But unfortunately, many persons have not mastered this technique. We have, therefore, applied the method of determinants to the set of equations for them, and have set up the resultant combinations in a form that involves straightforward substitution of numerical values for the several r's. We have been careful to set up the work sheets in such manner as to involve the maximum amount of recurrence of large units, so that the worker may merely look back at his earlier computations for the values of these large units instead of evaluating them again. The algebra is as simple as it can be but the worker will soon discover that this work is notoriously susceptible to clerical errors. In view of this tremendous susceptibility to clerical error, the worker is strongly advised to do the work twice on separate work sheets and, the second time through, compare his results with the original at the end of each unit. It is even better to have two workers proceed simultaneously, comparing results at the end of each unit. Complete agreement between the two should be demanded.

The work sheets will be given after a set of preliminary directions for their use.

GENERAL INSTRUCTIONS FOR USING THE COMPLETED-DETERMINANTS WORK SHEETS

1. All the needed simple ("zero-order") correlations must have been computed, using any suitable method.
2. Substitute the values of the simple correlations in the work sheets, just above their respective symbols.
3. Perform the indicated multiplications and additions within each set of parentheses or brackets and write above each of these the values of the quantities. (Some items have index letters above them. See below.)
4. Aggregate these values by algebraic addition, thus finding the value of each of the S's.
5. Substitute these S values in the transformed regression equations given at the end of the work sheet.
6. Index letters above the items indicate that the items will be repeated later. Where there is such a repetition, the index letter is used instead of the quantity in later occurrences. Capitals refer to quantities in brackets; small letters, to quantities in parentheses. Letters in the margin show the items to be found in that line. It is highly advantageous to write above each letter in the margin its numerical value, so that reference may readily be made to it when needed later.

The work sheets are set up for standard measures. They give the relative weights of the factors *intrinsically*—that is, independently of

the question of differing variabilities of the particular scales by which they were measured. Ordinarily this is what one wishes to know. But if you wish to know by what you must multiply the several *scores* before you average them, when these are not in terms of equal variabilities (such as sigma scores, T-scores, or P.E.'s, or other scores known to be all of the same variability), you must take account of the differing variabilities. If, following our custom up to this point, we call our criterion factor 0, our several independent factors 1, 2, 3, etc., our regression coefficients from standard measures B_1, B_2, B_3, etc., and our regression coefficients from ordinary measures b_1, b_2, b_3, then

$$b_1 = \frac{\sigma_0}{\sigma_1} B_1, \qquad b_2 = \frac{\sigma_0}{\sigma_2} B_2, \text{ etc.}$$

Remembering these equivalents, our regression equation then becomes:

$$X_0 = b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + \ldots\ldots + b_nX_n \quad -K$$

If, further still, you wish to *predict a score on the criterion* you must not only use b's instead of B's in the above equation but must also substitute for the final K and solve the whole equation. The value of K is found by multiplying each of the means of the variables other than the criterion, X_0, by its respective regression coefficient, summing these products and subtracting from this sum the mean of the criterion. The formula on the page following the work sheet will give detailed directions for doing this.

WORK SHEET FOR THE COMPLETED DETERMINANTS METHOD

THREE VARIABLE PROBLEM

The needed simple correlations are r_{01}, r_{02}, r_{12}, which are to be substituted in the following formulæ:

$$S_{01} = r_{01} - r_{02}r_{12}, \quad S_{02} = r_{02} - r_{01}r_{12}, \quad S_{00} = 1 - r^2_{12}$$

For the regression equations with which to use these S values, see page following work sheet.

FOUR VARIABLE PROBLEM

The needed simple correlations are r_{01}, r_{02}, r_{03}, r_{12}, r_{13}, r_{23}.

$$S_{01} = \underset{a}{r_{01}}\ (1 - r^2_{23}) - \underset{b}{r_{02}}\ (r_{12} - r_{13}r_{23}) + \underset{c}{r_{03}}\ (r_{12}r_{23} - r_{13}) \qquad a\ b\ c$$

$$S_{02} = r_{02}\ (1 - r^2_{13}) - r_{01}\ \underset{d}{(b)} - r_{03}\ (r_{23} - r_{12}r_{13}) \qquad d$$

$$S_{03} = r_{01}\ (c) - r_{02}\ (d) + r_{03}\ (1 - r^2_{12})$$

$$S_{00} = (a) - r_{12}\ (b) + r_{13}\ (c)$$

For the regression equation with which to use these S values, see page following work sheet.

THE FIVE VARIABLE PROBLEM

The simple correlations needed are r_{01}, r_{02}, r_{03}, r_{04}, r_{12}, r_{13}, r_{14}, r_{23}, r_{24}, r_{34}.

$$S_{01} = r_{01}\underset{Aa}{[}(1-r^2_{34})-r_{23}\underset{b}{(r_{23}-r_{24}r_{34})}+r_{24}\underset{c}{(r_{23}r_{34}-r_{24})}\underset{a\ b\ c\ A}{]}$$

$$-r_{02}\underset{B}{[}r_{12}\,(a)-r_{13}\,(b)+r_{14}\,(e)\underset{B}{]}$$

$$+r_{03}\underset{C}{[}r_{12}\,(b)-r_{13}\underset{d}{(1-r^2_{24})}+r_{14}\,(r_{34}-r_{23}r_{24})\underset{d\ C}{]}$$

$$-r_{04}\underset{D}{[}r_{12}\,(e)-r_{13}\,(d)+r_{14}\,(1-r^2_{23})\underset{D}{]}$$

$$S_{02} = r_{14}\underset{E\ \ e}{[}r_{23}\underset{f}{(r_{03}r_{14}-r_{04}r_{13})}-\underset{g}{(r_{02}r_{14}-r_{04}r_{12})}+r_{34}\,(r_{02}r_{13}-r_{03}r_{12})\underset{E\ e\ f\ \ g}{]}$$

$$-r_{24}\underset{F}{[}r_{13}\,(e)-\underset{h}{(r_{01}r_{14}-r_{04})}+r_{34}\underset{i}{(r_{01}r_{13}-r_{03})}\underset{F\ h\ i}{]}$$

$$+r_{34}\underset{G}{[}r_{13}\,(f)-r_{23}\underset{j}{(h)}+r_{34}\,(r_{01}r_{12}-r_{02})\underset{G\ j}{]}$$

$$-\underset{H}{[}r_{13}\,(g)-r_{23}\,(i)+(j)\underset{G\ H\ j}{]}$$

$$S_{03} = r_{14}\big[r_{23}\,(f)-(e)-r_{24}\,(g)\big]+r_{24}\big[r_{12}\,(e)-r_{23}\,(h)+r_{24}\,(i)\big]$$

$$+r_{34}\big[(h)-r_{12}\,(f)-r_{24}\,(j)\big]+\big[r_{12}\,(g)-(i)+r_{23}\,(j)\big]$$

$$S_{04} = [\,F\,]-r_{12}[\,E\,]-r_{23}[\,G\,]+r_{24}[\,H]$$

$$S_{00} = [\,A\,]-r_{12}[\,B\,]+r_{13}[\,C\,]-r_{14}[\,D]$$

When the values of the S's have been found they are to be substituted in the following regression equation, using the terms as far toward the right in the equation as the number of variables in the problem requires and considering the remaining ones equal to zero.

$$Z_0 = \left[\frac{S_{01}}{S_{00}}\right]Z_1 + \left[\frac{S_{02}}{S_{00}}\right]Z_2 + \left[\frac{S_{03}}{S_{00}}\right]Z_3 + \left[\frac{S_{04}}{S_{00}}\right]Z_4 \ldots$$

The quantities in brackets are the regression coefficients—the B's—and show the weights to be assigned the several factors independently of the particular variabilities of the scales by which they were measured. Any particular regression coefficient, it will be noticed, is merely the correspondingly numbered S divided by S_{00}. Indeed if only relative weights are wanted, and there is no concern to compare with standard

regression coefficients, it is unnecessary to compute the S_{00}, since the quotients are in the same ratio as the dividends.

If the regression coefficients are to be used for prediction purposes cognizance must be taken of the variabilities of the test scores; that is, the *B*'s must be translated into *b*'s by multiplying each by the ratio of its standard deviation to that of the criterion. The formula then becomes:

$$X_0 = \left[\frac{\sigma_0}{\sigma_1} \cdot \frac{S_{01}}{S_{00}}\right] X_1 + \left[\frac{\sigma_0}{\sigma_2} \cdot \frac{S_{02}}{S_{00}}\right] X_2 + \left[\frac{\sigma_0}{\sigma_3} \cdot \frac{S_{03}}{S_{00}}\right] X_3 + \left[\frac{\sigma_0}{\sigma_4} \cdot \frac{S_{04}}{S_{00}}\right] X_4 - K$$

The K that appears in this "score-form" regression equation is determined as follows:

$$K = \left[\frac{\sigma_0}{\sigma_1} \cdot \frac{S_{01}}{S_{00}}\right] M_1 + \left[\frac{\sigma_0}{\sigma_2} \cdot \frac{S_{02}}{S_{00}}\right] M_2 + \left[\frac{\sigma_0}{\sigma_3} \cdot \frac{S_{03}}{S_{00}}\right] M_3 + \left[\frac{\sigma_0}{\sigma_4} \cdot \frac{S_{04}}{S_{00}}\right] M_4 - M_0$$

where M_0 is the mean of the criterion, X_0; M_1 is the mean of the X_1 factor; M_2, the mean of the X_2 factor, etc.

THE MULTIPLE CORRELATION COEFFICIENT

A multiple correlation coefficient shows the expected correlation between the criterion and the team of independent variables when these latter have been given their best weight (as indicated by the regression coefficients) before they are averaged. When the regression coefficients have been found by either of the methods set forth above, the multiple correlation coefficient is easily computed by the following formula:

$$R^2_{0.}(123\ldots n) = B_1 r_{01} + B_2 r_{02} + B_3 r_{03} + \ldots + B_n r_{0n}$$

In other words, the multiple correlation coefficient is the square root of the sum of your several regression coefficients each multiplied by the r with a correspondingly numbered subscript.

PARTIAL CORRELATION COEFFICIENTS

A coefficient of partial correlation shows the extent to which two variables are correlated when the influence of certain others is held constant; for example, how scholarship is related to participation in extra-curricular activities when the factor of general intelligence is held constant, or how leadership is related to general intelligence when stature, social status of the home, participation in athletics, and self-confidence are all held constant. Partial correlations tell much the same story as regression coefficients. But for most purposes regression coefficients have a more significant meaning and, especially since they are much more easily computed, should ordinarily be used instead of partial correlations. Nevertheless, since some purposes require partial correlations, we shall set forth

methods for calculating them with the aid of the work sheets already presented.

Partial correlations are closely related to regression coefficients. In fact they would be precisely the same thing if the variabilities of our measures would remain everywhere equal. But, even if we start with standard measures and hence with equal variabilities, our variabilities become unequal as we proceed through a partial correlation problem. For when the influence of a third or a fourth factor is eliminated in the correlation of a criterion with an independent, the variability of the latter is restricted so that $\sigma_{1.2}=\sigma_1\sqrt{1-r^2_{12}}$, $\sigma_{1.23}=\sqrt{(1-r^2_{12})(1-r^2_{13.2})}$, and so on with higher orders.[1] And because the r's in the various combinations are unequal, the partial sigmas become unequal in spite of us. Therefore, just as we found it necessary to multiply a B_1 by $\frac{\sigma_0}{\sigma_1}$ in order to get b_1, we must now multiply a regression coefficient by the ratio of its partial sigma to the partial sigma of the criterion in order to get the corresponding partial correlation.

If we are using the Completed-Determinants Method as set forth in this article the ratio of the partial sigmas required above is expressed by the radical, $\sqrt{\frac{S_{00}}{S_{11}}}$. Our formula for deriving any partial correlation from a corresponding regression coefficient then becomes of the following type: $r_{01.23\cdots n}=B_1\sqrt{\frac{S_{00}}{S_{11}}}$; $r_{0k.123\,..\,(-k)\,..\,n}=B_k\sqrt{\frac{S_{00}}{S_{kk}}}$.

The S_{00} is the one appearing in the Completed Determinants work sheet; the S_{11}, S_{22}, S_{kk}, constitute a new series that must be computed for the sake of the partial correlations, one for each desired correlation. Formulae for calculating these are given below.

If the regression coefficient has not already been computed for another purpose, it is not really needed for the partial correlation. In that case the formula to use is:

$$r_{0k.234\ldots(-k)\ldots n}=\frac{S_{ok}}{\sqrt{S_{oo}\cdot S_{kk}}}$$

where k stands for the number of any particular item between which

[1] $\sigma_{1.2}$ denotes the partial sigma and means the estimated standard deviation of the scores of factor 1 if the influence of factor 2 could be eliminated from them. Similarly $\sigma_{1.23\ldots n}$ denotes the estimated standard deviation of factor 1 when the influence of all factors indicated at the right of the decimal point have been simultaneously eliminated. A corresponding notation is employed for partial correlation; the digits at the right of the point denote the factors held constant. It is customary to use this notation also for partial regression coefficients of the kind we have been treating. We have avoided it merely for the sake of simplicity.

and the criterion you wish to find the partial correlation. Both the S_{ok} and the S_{oo} are provided in the work sheets already set forth but the S_{kk}'s require new formula, just as above.

We shall now give these added formulæ which are to be used in the same manner as in the former Completed-Determinants work sheets. Where index numbers are used in parentheses they refer to quantities previously evaluated and designated by the same letters. Letters preceding k refer to quantities in the earlier work sheet. The formulæ are set up in such shape as to lend themselves best to the use of a Monroe calculating machine. The worker is advised to carry an extra 1 in the machine wherever there is prospect that the sign of the sum may otherwise change during the process.

THE THREE VARIABLE PROBLEM

$$S_{11} = 1 - r^2_{02} \qquad S_{22} = 1 - r^2_{01}$$

THE FOUR VARIABLE PROBLEM

$$S_{11} = 2r_{02}r_{03}r_{23} + 1 - r^2_{02} - r^2_{03} - r^2_{23}$$

$$S_{22} = 2r_{01}r_{03}r_{13} + 1 - r^2_{01} - r^2_{03} - r^2_{13}$$

$$S_{33} = 2r_{01}r_{02}r_{12} + 1 - r^2_{01} - r^2_{02} - r^2_{12}$$

THE FIVE VARIABLE PROBLEM

(Remember that the letters in parentheses or in brackets up to k refer to quantities evaluated in the earlier work sheet.)

$$S_{11} = \overset{k}{[A]} - r_{02}\overset{\lambda}{[r_{02}(a) - r_{23}(r_{03} - r_{04}r_{34}) + r_{24}(r_{03}r_{34} - r_{04})]}$$

$$+ r_{03}\overset{m}{[r_{02}(b) - (k) + r_{24}(r_{03}r_{24} - r_{04}r_{23})]}$$

$$- r_{04}[r_{02}(e) - (\lambda) + r_{23}(m)]$$

$$S_{22} = \overset{n}{[(a) - r_{13}(r_{13} - r_{14}r_{34}) + r_{14}(r_{13}r_{34} - r_{14})]}$$

$$- r_{01}[r_{01}(a) - r_{13}(k) + r_{14}(1)]$$

$$+ r_{03}\overset{e}{[r_{01}(n) - (k) + r_{14}(r_{03}r_{14} - r_{04}r_{13})]}$$

$$- r_{04}[r_{01}(o) - (\lambda) + r_{13}(e)]$$

$$S_{33} = \overset{p}{[(1 - r^2_{24}) - r_{12}(r_{12} - r_{14}r_{24}) + r_{14}(r_{12}r_{24} - r_{14})]}$$

$$
\begin{aligned}
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{s}{} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{t}{} \\
&-r_{01}\left[r_{01}\,(p) - r_{12}\,(r_{02} - r_{04}r_{24}) + r_{14}\,(r_{02}r_{24} - r_{04})\right] \\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{u}{} \\
&+r_{02}\left[r_{01}\,(q) - (s) + r_{14}\,(r_{02}r_{14} - r_{04}r_{12})\right] \\
&-r_{04}\left[r_{01}\,(r) - (t) + r_{12}\,(u)\right] \\
S_{44} = \quad & \underset{v}{} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{w}{} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{x}{} \\
&\left[(1 - r^2_{23}) - r_{12}(r_{12} - r_{13}r_{23}) + r_{13}\,(r_{12}r_{23} - r_{13})\right] \\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{y}{} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{z}{} \\
&-r_{01}\left[r_{01}\,(v) - r_{12}\,(r_{02} - r_{03}r_{23}) + r_{13}\,(r_{02}r_{23} - r_{03})\right] \\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \underset{g}{} \\
&+r_{02}\left[r_{01}\,(w) - (y) + r_{13}\,(r_{02}r_{13} - r_{03}r_{12})\right] \\
&-r_{03}\left[r_{01}\,(x) - (z) + r_{12}\,(g)\right]
\end{aligned}
$$

We can also use the Doolittle work sheets, given in our previous article, for computing partial correlations, though the procedure is somewhat more cumbersome. The use of that method also requires multiplying the obtained regression coefficients by a factor which is equal to the ratio of the partial sigmas. The formula to use for that purpose is as follows:

$$
r_{01.2} = B_1\sqrt{\frac{1-R^2_{2'(01)}}{1-R^2_{0'(12)}}}; \qquad r_{0k.123\,..\,(-k)\,...\,n} = B_k\sqrt{\frac{1-R^2_{k'(0123..(-k)..n)}}{1-R^2_{0'(123.....n)}}}
$$

$r_{01.2}$ is the partial correlation between factors 0 and 1 with the factor 2 held constant. $r_{0k.123\,...\,(-k)\,...\,n}$ is the generalized case where k is any factor to be correlated with the criterion while all the others are held constant. The symbol (—k) is used to indicate that the k is absent from the right side of the point because it is used on the left side. The B's are the regression coefficients dealt with in our earlier sections. The $R_{0.\,(123\,...\,n)}$ is the multiple correlation between the criterion and all the other factors combined (treated in our last section above), while the $R_{k.\,(0123\,..\,(-k)\,..\,n)}$ is a similar multiple correlation in which k (the factor between which and the criterion you wish to find the partial correlation) has been shifted into the position of criterion in exchange for the old criterion which now replaces it in the group to the right of the point. You have probably already computed the basic multiple correlation. You will need now to compute, in addition, a series of new mul-

tiple correlations by shifting into the position of criterion in turn each item in which you are interested.[2]

The easiest way in which to avoid confusion in making this interchange is to write out a table of new equivalents for the original correlations. Suppose you wish, in a four-variable problem, to shift factor 3 into the criterion place in exchange for factor 0. You must substitute a 0 for each 3 and a 3 for each 0.

New	r_{01}	= old	r_{13}
	r_{02}	=	r_{23}
	r_{03}	=	r_{03}
	r_{13}	=	r_{01}
	r_{23}	=	r_{02}

Any correlations not containing factors 0 or 3 are unaffected. Letting all correlations stand in the work sheet exactly where they now are, substitute for those affected the new values. Then proceed precisely as the work sheet directs. The new multiple correlation coefficient will be the one you need for the numerator of the fraction under the radical in your conversion formula. Do a similar thing for each partial correlation in which you are interested. This can be done for problems of any number of variables and for the larger number of variables is, we believe, a far more economical method than the one customarily used. A part of the economy of the method with a large number of variables lies in the fact that a considerable fraction of the computations remain unchanged when a new multiple correlation coefficient is being computed. If you are interested in only one partial correlation give the item involved in it the highest number. Then you will find that the only new arithmetical processes you need to perform will be one little section at the lower right-hand corner of the work sheet.

[2] The B outside the radical is always one of the basic ones, the ones that go with Ro. (123 . . . n).

SHORTER ARTICLES

INTERPRETATION OF REACTIONS TO THE PINTNER-PATERSON PERFORMANCE SCALE*

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IT is the writer's purpose to present in suggestive form what has been found to be of interpretative interest in the administration of the Pintner-Paterson Performance Scale; to show how it is possible by an analysis of the subject's reactions to gain a descriptive evaluation of his intellectual status in addition to the numerical score obtained on the examination.

The conclusions are based on the writer's examination of one hundred patients at the Wayne County Psychopathic Clinic, Detroit, and two hundred patients examined at the Neuro-Psychiatric Clinic, Out-Patient Department, Harper Hospital. The first group of subjects is unselected, including patients from five to forty-five years of age of both sexes, some of them handicapped by language difficulty and others speaking only English. Each subject was given a Stanford-Binet and a Pintner-Paterson Performance Scale. The second group of subjects was similarly unselected as to age and sex, but was composed of patients for whom a language test was unsuitable, because of language difficulty, and in some fewer cases because of illiteracy, speech defects, deafness, or mutism. The members of the second group were given only a Pintner-Paterson Performance Scale.

First of all, and of primary importance in a study of the subject's reactions, is his response to the presentation of the tests. In the writer's experience, it is the person of good intelligence who will accept the tests as problems or puzzles to be solved which in themselves arouse sufficient interest to sustain the effort necessary for success; he will need little explanation, urging, or encouragement. On the other hand, the person of decidedly defective intelligence will often meet the tests with an unquestioning acceptance, without comment, with little display of interest, and often with a delayed response which betrays his failure to grasp readily the requirements of the tests.

* Pintner, Rudolph, and Paterson, Donald G. *A Scale of Performance Tests.*

Between these two subjects, who represent opposite levels of intelligence, is the subject of borderline intelligence who, especially if an adult, is more likely to be antagonistic and suspicious, and to show himself possessed of the idea that the test is a reflection on his intelligence, or else is an effort to establish his insanity or incompetency. In either case he will often demur about attacking the tests, and in the first instance even after the attempts which he has been urged to make have demonstrated that the tests present, at least for him, sufficient difficulty, he will sometimes continue to regard them as "foolish," or "for children."

In the same manner, the subject's method of arranging the blocks may be given a rank indicative of its degree of merit according as it shows evidence of planfulness. The method of the most intelligent subject is entirely planful. He displays good judgment by attacking the simplest figures first, and shows foresight by deliberating more or less before attempting a placement. He is quick to see the relationship between parts and their whole, recognizes failure and success, does not repeat his errors, but shows resourcefulness and originality by varying his moves.

A second method of attack next in merit makes use of trial and error, but still with some display of planfulness; that is, after having placed a block successfully but apparently only by chance, instead of selecting a block at random, the subject will very evidently be looking with more or less success for the block with which to complete the figure already begun.

There follows and of somewhat poorer quality than the preceding one, the performance in which, though almost entirely trial and error, the subject after trying a block in successive holes will be conscious of his failure and will have sufficient resourcefulness so that he will vary the position of the block, or after a certain number of failures will select another block.

Still more inferior is the method that is entirely trial and error, in which no evidence of plan can be detected and yet does show that the subject is not entirely without a notion of the purpose of the test, and shows that he is at least trying to fit the blocks in their places. The individual will usually select the first block at hand and will consume almost the whole time limit trying it in successive holes without varying the position of the block, an entirely resourceless and planless performance. He may persist without any urging, or he may give up his efforts after a time, not so much because he appreciates his failures, but because he lacks the stimulus to continue.

The most inferior of all will be the performance in which the subject plays with the blocks, handles them aimlessly, or places them in spaces which though large enough to receive them are entirely inappropriate, and then manifests no dissatisfaction with the results, showing that he does not grasp even the problem presented by the test.

In like manner, the subject's method of manipulation may be descriptively analyzed and translated, to fit its place on a scale of varying degrees of excellence. The most intelligent subject will rank at the top with a display of movements which are accurate, well-timed, and well-directed. The subject next on the scale is the one who moves in a slow, fumbling, awkward fashion; or makes hasty, purposeless, or often incomplete moves. Then farther down the scale is the subject who expends an entirely unnecessary amount of energy, using force, and employing the palm of his hand or even his fist to force the blocks in place. Last, and most inferior of all, is the defective individual who in his grasping movements fails to juxtapose the finger and thumb and whose manipulation differs but little from that of an ape.

There are a few types of response which do not seem to be related to levels of intelligence, such as those that show a varying amount of planfulness in which the subject will demolish what he has partially completed, thereby indicating that he lacks the ability to appreciate success, and that he had been directed in his efforts by little idea of the goal. Then, too, there are some subjects who will hit upon the plan of working for the completion of figures outside the board, afterward placing them in position. Although this procedure has the advantage of eliminating the penalty for errors, it is of doubtful mental significance, since the subject has no knowledge of whether or not it is a desirable method. In the writer's observation it has been impossible to relate this procedure to intelligence since it has been met with in subjects of somewhat inferior and also in those of higher intelligence.

Although with the majority of subjects the number of errors that they make in a test will give them a rank very nearly corresponding to their score on time, there are those who make a consistently higher score on time than on errors, while others perform in an opposite manner and gain a better score on errors than on time. Obviously, then, it is possible to add to the description of a subject the fact that, if his performance is of the first sort, he is a rapid but less careful worker; or if his reactions are of the second kind that, although slow in his responses, he is careful and painstaking.

As a means of gaining further insight into the subject's mental equipment it is possible to think of the tests as consisting of, first, those of the form-board type and involving more or less the factor of chance in their successful completion; and, second, those that involve a certain amount of meaning, a recognition that is more or less necessary for success. The first group includes: the Seguin Form Board, the Five Figure Board, the Two Figure Board, the Casuist Form Board, the Triangle Test, the Diagonal Test, and the Healy Puzzle "A." The second group includes: the Mare and Foal, the Manikin Test, the Feature Profile, the Ship Test, and the Picture Completion. There are several additional tests that do not fall into either grouping, such as the Substitution Test, Adaptation Board, and the Cube Test.

It is interesting to note whether or not the subject is more successful with the tests of one type than with those of the other, and, particularly, to observe how successfully he grasps the meaning as it is involved in each of those of the second group. Does he, for instance, at sight of the Manikin exclaim, "Oh, a man!", or of the Feature Profile, "That's a face?" Or does this knowledge of the meaning come to him only after a certain number of placements, or perhaps not at all, as, for instance, would be shown in the Ship Test by his placing the blocks without any regard to their formation of the figure, perhaps upside down, and then evidencing his apparent satisfaction with the result? With the idea correctly established, does he show by his first attempts that he fails to note anything except the grosser elements; and then does he by successive placements effect an improvement, and possibly, final success? In the Picture Completion Test he may, after making a few placements, apparently lose the goal idea and instead of selecting blocks suitable to the spaces fall into the error of attempting to find a space suitable for each one of the blocks. This method is, of course, impossible to put into effect, as may be manifested in the bewildered and unsatisfied attitude of the subject who, after he had filled all the spaces, finds remaining squares in the box.

The following descriptive summary of the results of a Pintner-Paterson Performance Test is offered as a concrete illustration of the application of the preceding comments:

The subject is a Polish woman forty-six years old employed as a char-woman. She has been in this country twenty-two years and, according to her statement, is literate in her own language and able to read and write a little in English. She is, though, so limited in her use and understanding of English that it was difficult to make her comprehend and quite as difficult to understand what she was trying to say.

"She accepted the tests unquestioningly and with no apparent interest, was not very persistent, inclined to give up, and had to be encouraged to continue.

Her movements were slow and clumsy, her fingers seemed insensitive to touch and she scratched and picked at the blocks in her attempts to handle them. She used her right hand to the complete exclusion of her left; even when the board was in danger of falling off the table, she would not attempt to control it with her left hand.

There was little that was planful in her method; sometimes after placing a piece successfully she would appear to be looking for another piece to complete the figure, but she was so slow to see relationships that the result was usually trial and error only. She repeated the same errors and the same attempts at impossible placements; showed little foresight.

In the tests having meaning, she seemed to have little idea of what was involved. The Manikin was a success but the Feature Profile was not completed (she did not recognize the fact that it was a head); the Ship she pronounced "water and a factory;" on the Picture Completion most of her placements were absurd, and she evidently had difficulty making a decision as to which block to use."

The final score was a mental age of 7.65 years and an intelligence quotient of 51.

It appears that not only does the intelligence quotient classify her as inferior in intelligence but her behavior during the examination also, and her attitude toward it, lack of insight into its purpose, her clumsy movements, inferior method, and failure to grasp the significance of the "meaningful" tests. All these are in keeping with such a classification, as are also her inferior industrial status and her failure to acquire an understanding of the English language during twenty-two years of residence in this country.

In conclusion, it may be pointed out that the ideal means of evaluating a subject's intelligence obviously includes a battery of performance tests such as have been described, as well as tests involving the use of language. The writer believes that such a combination of tests is desirable. No matter how many, and what type of test may be employed, it is well to gain from each the greatest possible insight into the subject's mental equipment, not only from the gross response in terms of mental age, but also in terms of the characteristic qualitative differences in the method of test solution by the subjects. The interpretations are unusually valuable when the total number of tests administered is sometimes unavoidably limited.

THE INFLUENCE OF A SECONDARY COURSE IN ZOOLOGY UPON GAINS IN COLLEGE ZOOLOGY

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WITH the data available from the use of educational scales devised for measuring the range of information in five large classes in an intro-

ductory course in college zoology, it was feasible to compare the gains made by students who had previously taken a course in high-school zoology with the gains made by students who had had no such course.[1] The gains were expressed in comparable amounts based on a uniform unit of measurement. These classes consisted of two academic classes, Section I and Section II, in an elective ten-credit course for two quarters; a pre-medical class and a pre-dental class in a twelve-credit required course throughout the year; and one academic class, designated as Academic 1 W, in a ten-credit course for the winter and spring quarters. In each of the five classes there were a few students, as indicated in Table I, who had had a course in zoology in high school. There were also a much larger number who had not had such a course in high school and who had had no previous course in zoology in college.

TABLE I

NUMBER OF STUDENTS IN EACH CLASS HAVING HAD ZOOLOGY, AND THE NUMBER IN EACH CLASS WHO HAD NOT HAD ZOOLOGY

Classes	Number who had Zoology in High School	Number who did not have Zoology in High School
Academic 1 W	11	66
Pre-medical	10	66
Pre-dental	14	57
Section I	15	85
Section II	12	78

In the case of the Academic 1 W class the initial test was given on the opening day of the course. In Section I and Section II, it was

TABLE II

MEAN SCORES MADE IN THE SCALES FOR MEASURING RANGE OF INFORMATION IN ZOOLOGY AT THE THREE SUCCESSIVE TESTS

	Initial Measurements		Second Measurements		Final Measurements	
Classes	Scale A	Scale B	Scale A	Scale B	Scale A	Scale B
Academic 1 W						
No Zoology in H.S.	74.77	75.67	87.29	87.44	96.29	97.45
Had Zoology in H.S.	81.09	79.73	89.	87.82	97.0	97.27
Pre-medical						
No Zoology in H.S.	82.59	83.73	91.36	90.48	100.98	102.53
Had Zoology in H.S.	85.6	82.7	91.9	91.4	102.8	104.4
Pre-dental						
No Zoology in H.S.	82.42	83.1	88.89	90.1	97.75	98.02
Had Zoology in H.S.	84.21	81.0	88.78	87.0	97.71	94.86
Section I						
No Zoology in H.S.	84.47	86.29	89.15	90.74	101.94	102.32
Had Zoology in H.S.	88.33	88.53	94.4	91.73	106.4	106.06
Section II						
No Zoology in H.S.	86.05	89.1	91.32	92.68	105.68	105.32
Had Zoology in H.S.	88.25	89.91	92.0	93.0	104.	105.41

[1] The measurements from which these results were derived were made with the coöperation and assistance of the several members of the Department of Zoology at the University of Minnesota during 1926-1927.

given when the course was one-fourth completed; and in the pre-medical and the pre-dental classes, it came when one-sixth of the course had been completed. In Table II are given the initial, the middle, and the final measurements made during the college course with the two scales available, Scale A and Scale B.

In view of the fact that the initial tests were given at different points in the course, it follows that the average scores should, in a measure, reflect a variation commensurate with the part of the course which was covered before the initial test was given; that is, the class which took the initial test the first day of the course should have a lower mean score than the classes taking it when one-fourth of the course had been covered, while the mean score of the classes that took the initial tests when one-sixth of the course had been completed should occupy an intermediate position. In Table II, it is apparent that the mean score of each class in the initial test reflects this condition regardless of whether the measure is based on Scale A or on Scale B. Similarly, the average gain made during the first half of the course, the difference between the initial and the second measurement, should reflect the length of time devoted to achievement in zoological information since the initial measurement was taken. On this basis, the mean of the gains for the Academic 1 W class should be the highest, followed by those of the premedical and pre-dental students with the two mean gains for Section I and Section II the lowest. The data of Table III confirm this premise. The difference between the mean scores in the second and final measurements in Table II may be taken as indices reflecting the variations characterizing each of the classes considered.

The data in Table II show that the students who had had a high-school course in zoology tended to make slightly higher mean scores on both scales than the students who had had no such course. The difference, however, is surprisingly small in comparison with the gains made during the college course in zoology. The zero point of this range of information scales is not an absolute zero point. The range of information possessed by the students who have not had a high-school course in zoology is surprisingly large in comparison with the gains.

For those who had zoology in high school, the mean score in the final tests for Section I and for the pre-medical class is higher than the mean score of those who did not. In the case of the pre-dental students, the mean score of those who did not have zoology in high school is higher than the mean score of those who had it. In Section II and Academic

1 W the mean score on one scale is higher for those who had zoology in the high school, while on the other scale those who did not have zoology in high school are in the lead; in the case just cited the differences are slight and may be considered as negligible. From these data there is no clear-cut evidence to show that those who took zoology in the high school have a wider range of information at the end of a college course in that subject than those who took the subject for the first time in college.

Presumably it is fair to assume that all instruction is fundamentally concerned with the gains made during the course. If we turn to Table III, we note that in every case except one the students who had had no zoology made larger gains during the first half of the course than those who had had such a course. This is unexpected, in view of the fact that for the students who had had zoology part of the course must have been a review, or it involved relearning a few things that they had already learned but partly forgotten. For the second half of the course, the gains are again in favor of those who had had no zoology in six cases out of the ten.

TABLE III

MEAN GAINS MADE BY EACH OF THE FIVE CLASSES IN THE FIRST AND SECOND HALVES OF THE INTRODUCTORY COLLEGE COURSE IN ZOOLOGY

	Gains for First Half		Gains for Second Half		Total Gains	
Classes	Scale A	Scale B	Scale A	Scale B	Scale A	Scale B
Academic 1 W						
No Zoology in H.S.....	12.52	11.77	9.0	10.01	21.52	21.78
Had Zoology in H.S.....	7.91	8.09	8.0	9.45	15.91	17.54
Pre-medical						
No Zoology in H.S.....	8.77	6.75	9.62	12.05	18.39	18.8
Had Zoology in H.S.....	6.3	8.7	10.9	13.0	17.2	21.7
Pre-dental						
No Zoology in H.S.....	6.47	7.0	8.86	7.92	15.33	14.92
Had Zoology in H.S.....	4.57	6.0	8.93	7.86	13.5	13.86
Section I						
No Zoology in H.S.....	4.68	4.45	12.79	11.58	17.47	16.03
Had Zoology in H.S.....	6.07	3.2	12.	14.33	18.07	17.53
Section II						
No Zoology in H.S.....	5.27	3.58	14.36	12.64	19.63	16.22
Had Zoology in H.S.....	3.75	3.09	12.0	12.41	15.75	15.5

Referring to the total gains in Table III, it is apparent that in three classes, namely, the Academic 1 W, the pre-dental class, and Section II, the students who did not have zoology in high school made greater gains as measured by both Scale A and Scale B. In Section I, the greater gain was made by those who had had zoology in high school. For the pre-medical class, measurements on Scale A indicate a greater mean gain for those who had not had a previous course in zoology before taking their university course in that subject, while on the basis of Scale B

those who had zoology in high school seem to have been able to make a trifle better showing. If we average the mean gains of the pre-medical class, however, the very slight difference is in favor of the ones who had had the elementary course in zoology. In general, then, it appears, from this study, that students who have had an elementary course in zoology in high school achieve less in a college course in that subject than do those who are taking the subject for the first time.

From the data cited in this study, it is apparent that students who have had a previous elementary course in zoology in high school have a pronounced lead over the others at the beginning of the course, but that as the college course in zoology progresses this lead is reduced. In most instances, such students are outclassed in final attainment as well as in gains made during the course by those who have not had such an elementary course.

THE EFFECT OF SEX DIFFERENCES IN THE STUDY OF GENERAL SCIENCE

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THAT boys are, in general, superior to girls in the scientific school studies has been a popularly accepted educational belief. Cattell's study, in 1903, of the one thousand most noted individuals of the civilized world showed that in his opinion there was only one woman who could be classed as an eminent scientist, and this woman, Mrs. Somerville, was hardly more than a popularizer of scientific results and was not in fact eminent because of her own scientific attainments. Since Cattell's work, a much larger percentage of women have entered into scientific lines, but none of these, with the exception of Madame Curie, are as yet credited with being outstanding in the field of scientific research.

The physical differences between male and female are so much in evidence that most people have readily acquired the idea that there must exist some distinct mental differences between the two sexes. Possibly a mental prejudice enters into the situation to lessen the general intense scientific interest among school girls. For example, several girls in my own scientific teaching experience had built up an inferiority complex in the belief that girls were never intended to be good in scientific subjects, hence they, as girls, were personally handicapped before even beginning the study, and, therefore, they asked, "Why try at all?" Other science teachers have testified similarly, and I suspect that this

science inferiority complex has been quite common among girl pupils in past generations of school work.

School grade studies on all scholastic levels, like that made by Miss Rusk in the high school and by Dr. Thompson in college, almost always show a distinct male superiority in scientific subjects. Gault believes environment to be the chief cause for this difference, and Hollingworth and Poffenberger elaborate the idea by stating that custom is the powerful factor in determining what should be the sphere and interests of the sexes. Terman is inclined to credit the possession of giftedness as the most important factor in the mastery of any school subject. The more recent opinions are almost unanimous in minimizing the amount, if any, of sex differences in intellectual ability.

During one school term, eight tests of the objective true and false type consisting of fifty questions each (total of four hundred questions) were given to members of five General Science classes in one of the Pasadena junior high schools. The questions were based in part upon the contents of the textbooks in use and in part upon the series of laboratory experiments carried on as individual projects by the members of the five classes. About two weeks intervened between tests throughout the term. Competitive spirit was brought into full play by posting the relative standings of the classes on the bulletin board after each test, and by promising the class that made the best comparative record at the end of the term a trip to the beach. Also, it was understood that the test marks counted one-third of the final grade and that absences from tests counted zero for that part of the student's record but did not penalize the class as a whole. There is very little question but that the great majority of the students, both boys and girls, were working to their best capacity in these tests. Let it be added, however, that the idea of competition between the sexes was not brought before the students.

The results of the eight science tests were correlated with the IQ records secured from the Terman intelligence tests, which are a fundamental part of the Pasadena junior high-school testing program. Correlations were made by the Pearson product moment method and all correlations were positive as follows:

CORRELATION CHART

All Pupils, Boys and Girls	.46	P.E. $\pm$ .05
Boys only	.42	P.E. $\pm$ .07
Girls only	.51	P.E. $\pm$ .06

Records from only the one hundred and nineteen pupils who were present and took all eight tests were used in making the above correlations.

Records of pupils entering late or leaving early were entirely disregarded as were those records of any students with absences.

In these tests boys showed a slight superiority over girls. Figure I compares by normal curves the boys' record with that made by the girls. The curve representing the achievement of the boys is given in a heavy line, that for the girls in a dotted line. Fifty-seven percent of the boys equalled or exceeded the median of the girls. The figure shows graphically that there is, in truth, very little difference between General Science abilities of boys and girls, as far as these tests are reliable criteria.

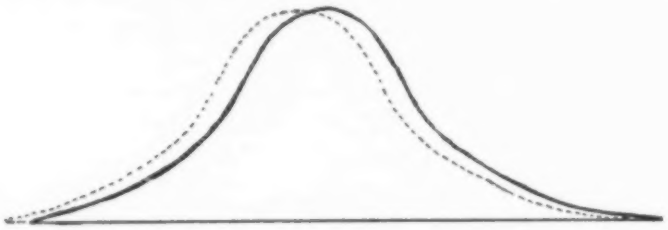

FIGURE I

THE AMOUNT OF DIFFERENCE IN ABILITIES BETWEEN BOYS (SHOWN IN HEAVY LINE) AND GIRLS (SHOWN IN DOTTED LINE) IN GENERAL SCIENCE TESTS. FIFTY-SEVEN PERCENT OF THE BOYS EQUALLED OR EXCEEDED THE MEDIAN OF THE GIRLS

One other factor that must be included in this study is the relative degree of intelligence of the boys as a group and of the girls as a group as determined by the Terman group intelligence tests. Terman himself indicates that in junior high schools, girls are as a rule slightly superior to boys in intelligence. His figures based upon the difference in mental age, all of them in favor of the girls, are shown below in comparison with the IQ records of students taking the General Science tests. The Pasadena records show a less appreciable IQ difference between the junior high-school boys and girls in those groups that were given the Science tests than between the boys and girls whom Terman studied.

Average Chronological Age	Terman's Study Percent Superiority of Girls over Boys	This Study Percent Superiority of Girls over Boys
11.5	0.56	0.19
12.5	0.25	0.14
13.5	0.14	0.17
14.5	0.58	0.18

The Pasadena figures show only a slight advantage in intelligence in favor of the girls, but they later serve to emphasize slightly the superiority of the boys over the girls in General Science work.

Figure II shows graphically an interesting difference in variability between the sexes. This figure represents in intervals of three grade points the average grade of the student in all eight tests, and the number of students attaining each grade. The boys' record is shown in heavy lines and that of the girls in dotted lines. Girls tend to cluster more closely around the middle interval of 80-82 than the boys, who are more variable and have more grades at the extremes of the diagram with a little preponderance toward the higher grades. These graphic results tend to bear out Dr. Leta Hollingworth's statement that, "A rather common opinion among scientific men has been that men *are* more variable than women." .... (She adds, however) .... "When unfavorable environmental conditions are allowed for, and sufficiently large number of individuals are tested, differences in variability do not appear." The

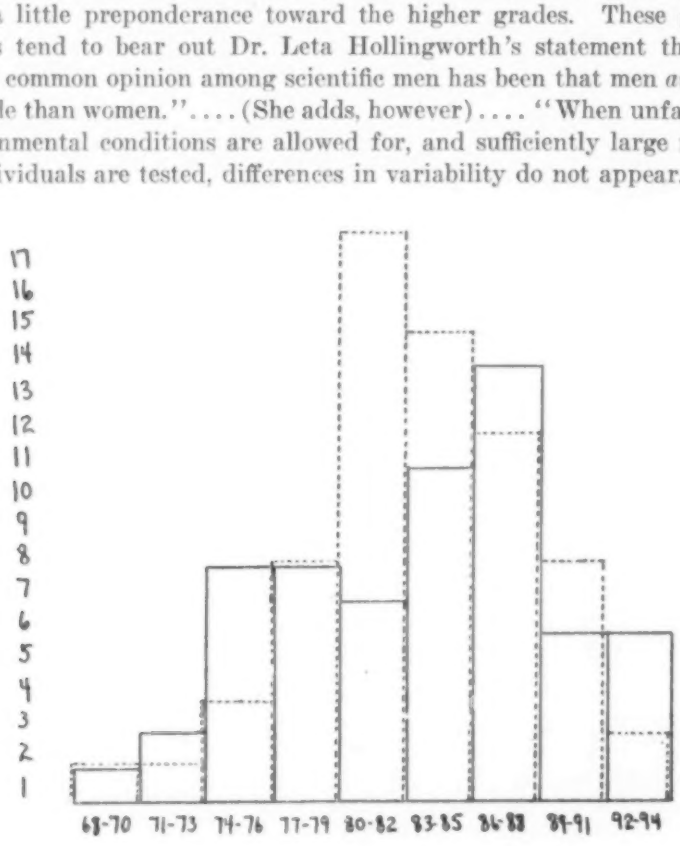

FIGURE II

COMPARISON OF BOYS (HEAVY BLACK LINE) AND GIRLS (DOTTED LINE) IN RESPECT TO AVERAGE GRADES IN EIGHT OBJECTIVE GENERAL SCIENCE TESTS. THE HORIZONTAL SCALE REPRESENTS THE AVERAGE GRADE RECEIVED, IN INTERVALS OF THREE. VERTICAL SCALE REPRESENTS NUMBER OF PUPILS ATTAINING THAT GRADE. SIXTY-THREE GIRLS AND FIFTY-SIX BOYS ARE REPRESENTED IN THIS FIGURE

boys in these particular science tests are more variable than the girls, but to a slight degree. Environmental changes which are rapidly occurring in the present lives of our future women may possibly be expected to wipe out even this slight degree of difference in variability.

This variability is shown better when statistical measures are applied to the data. The range for both boys and girls is the same, namely 68 to 94, or 26. The mean is likewise equal for both groups, being 83.16. The σ_s of 6.09 for boys and 4.86 for girls, a difference of 2.23, may be expressed by the σ (diff.) of .713. Thus we may say that the chances are 76 in 100 that the obtained difference of 2.23 in σ_s does not diverge from the true difference by more than $\pm$ .713; and that the chances are 99 in 100 that 2.23 does not differ from the true difference by more than $3\times.713$, or 2.139. To sum up these statistical findings, we may be almost certain that the true differences between the averages of the boys and of the girls lies within the limits of 2.23 ± 2.14, or between + .09 and + 4.37. The critical ratio of 4.63 is indicative of the reliability of these measures.

STATISTICAL RESUME

Scores	Boys	Girls
92-94	5	2
89-91	5	7
86-88	13	11
83-85	10	14
80-82	6	17
77-79	7	7
74-76	7	3
71-73	2	1
68-70	1	1
Total	56	63

Statistical Measure		
Mean	(Boys)	83.16
	(Girls)	83.16
σ	(Boys)	6.09
	(Girls)	4.86
σ (diff.)		.713
P.E. (diff.)		.481
C. R.		4.63

CONCLUSIONS

1. Boys show a slight superiority over girls in the study of General Science in-so-far as the above tests indicate.

2. The slight superiority in intelligence, as given by the Terman group test, in favor of the girls participating in this experiment, tends to strengthen the significance of the small amount of superiority in science shown by the boys over the girls.

3. Boys, as a rule, are considered more variable than girls. In this respect the data of this experiment agrees with the results secured from the great majority of similar experiments.

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EDITORIALS

WHEN SCIENCE GOES WRONG IN EDUCATION

Fortunately the time has passed when one must defend the applications of scientific method to education. The practical worker in education who wishes to pin his faith consistently upon the findings of science will have occasion to remind himself frequently that science is merely an instrument forged to realize educational aims and that scientific conclusions appropriate to one set of conditions are frequently inapplicable or invalid under other circumstances.

It is peculiarly important to remember the relative character of scientific conclusions when utilizing the results of studies that represent a consensus of opinion or group findings. Many applications of "scientifically established facts," for example, illustrate what one might call "the fallacy of the average." Thus extensive studies may be made in which two or more methods of teaching procedure are compared. If one of these methods clearly establishes its superiority over the others it is commonly concluded that it can be applied with profit to the teaching of all children, on the false assumption that what is true of groups will hold true of an individual child. A close competitor of the fallacy of the average is the fallacy of generalizing regarding a whole situation from data that applies only to a part. This failing is commonly detected in reports on experiments which attempt to measure the results of teaching large and small classes, or to determine the relative merits of the lecture-demonstration, the group-laboratory and the individual experimentation method in high-school science classes. Indeed the writer has read accounts of studies in which at the outset of a report the experimenter has confessed his inability to measure or to detect the presence of most significant factors in the situation, but nevertheless in the conclusion presumes to advise schools, on the basis of these partial results, to introduce the method which scored highest on the tests!

There is also the tendency to conclude that a truth is established merely because negative evidence is not for a time forthcoming.

One of the most striking illustrations of this fallacy is the uncritical organization of educational methods and materials in accordance with

Thorndike's conception of mental traits. About twenty-five or thirty years ago Thorndike and others undertook to determine to what extent information and methods acquired in one subject transferred over into another subject. They found a very low correlation, and Thorndike formulated in consequence his theory of specific learning. All learning, he contended, is a matter of perpetuating, eliminating, and modifying or redirecting connections between situations to which the learner is originally sensitive and responses with which he is originally endowed. That is to say, learning is specific and the mind consists of traits relatively discrete and relatively independent of each other.

As a result of this theory, founded upon experiment, the work of the schools began to undergo transformation. Courses of study came to be analyzed into specific objectives in the way of information, and habits and skills children are to acquire, and methods were formulated into specific things children should do in order to insure the acquisition of specific abilities. Carried out logically this theory of learning dissolves ideals, general principles, and attitudes. They become no more than collective nouns, blanket terms used to cover those elements common to a variety of situations. Few school men, however, who accept and apply this principle realize that like jack rabbits in Australia, it has multiplied and increased primarily because of the absence of competitive influences. They are unaware that the doctrine of specific abilities rests upon experimental evidence which is now being challenged. Thus Professor V. A. C. Henmon writes in a most significant article on "Measurements and Experimentation in Education:"

Whatever may be the causes, whether due to a common central factor or to group factors, the relationships between traits are not only positive but high. Imperfections in our measurements, not low relationship between mental traits appears from the accumulating evidence to have been the sounder interpretation. Our educational theorizing and practice have, however, been shot through and through and still are by notions of the extreme specialization of mental functions and the non-transferability of training. In a reaction against discipline we have made knowledges and skills sacrosanct. Karl Pearson maintained years ago that 'the true aim of the teacher must be to impart an appreciation of method and not a knowledge of facts. This is far more readily achieved by concentrating the student's attention on a small range of phenomena, than by leading him in rapid and superficial survey over wide fields of knowledge.' I believe in the soundness of both propositions but they run quite counter to the educational philosophy which has underlain much of our thinking on curriculum and methods for two

decades. The philosophy itself grew out of imperfect measurements and inconclusive experiments.

We venture, in conclusion, to suggest one more consideration which scientific workers and those who utilize the findings of science in education need constantly to have in mind. We refer to the relative character of scientific method itself.

Scientific method is sometimes thought of as a procedure that exists in its own right; something independent of the field in which it operates. A more workable conception, however, views science as the most refined and accurate process man has devised for analyzing and directing experience. Thus viewed the nature of scientific method is seen to vary with time, circumstance, and the subject matter under investigation.

This is merely saying that scientific method is a product of evolution. At each stage of evolution, however, there is an attempt on the part of workers in science to carry over into their respective fields the procedure which characterizes the most distinctive and the most successful accomplishments of "science." Thus in the days of Descartes, Newton, and John Locke mathematics and the method of mathematics seemed most fruitful. In consequence the mathematical method became idealized. To-day the natural sciences are winning dramatic victories and it is not a matter of surprise that scientific workers in education should wish to import into their provinces the methods of natural science.

There is at least one significant difference in the two cases which sanctions caution. The elements in a situation with which the physicist deals are known in the sense that they are definite and tangible, or, if varying, their changes are calculable.

In education, however, the factors operating in learning situations are neither so easily detected nor are they so readily assigned a value. They are not easily assigned a value because *factors* are commonly not *elements*.

Especially is this true when the factors are what we commonly call "traits." May we illustrate?

A theory of biology and psychology underlies the conception of traits. When biology believed in unit characters as entities present in the germ plasm, and relatively insulated from the soma plasm, it was possible to conceive of mental traits as the psychological correlates of unit characters. But when biologists abandoned this conception of the germ plasm, as they now seem to have done, and began to picture the carriers of heredity as chemical packets within each germ cell, a chemical packet, more-

over, which is subject to conditions outside as well as inside the germ plasm, the line between heredity and environment became blurred and took on the character of functions of more than one variable.

Manifestly, if traits are the functions of a variable heredity and a unique and individual environment, they can be measured and described only as manifestations of a living being, under given circumstances and at a given time.

This conclusion applies not only to the value of mental traits, but to behavior traits as well, and even to the traits listed on a teacher rating scale!

We may conclude then that the critically minded educator will be wary in his use of science. He will endeavor to bear in mind that at best science is an instrument designed to realize values and ends which may require justification outside the field of scientific method. Consequently he who uses an instrument of science must assure himself that the ends thus promoted are in themselves worthy. Secondly our sophisticated educator will scrutinize "scientific" findings with a view to determining the extent and the conditions of their validity. He will hesitate to build a program upon conclusions that derive from data only partially representative of a total situation, and he will be chary of hypotheses which stand merely in the absence of conflicting evidence. And finally he will realize that there are certain permanent limitations upon the applications of science to education for the reason that the factors which function in a learning situation are often chameleon-like and in consequence different from the definite and tangible elements with which scientists in other fields may operate.

Nevertheless there are certain general characteristics of scientific method which are indispensable instruments for progressive teaching and supervision. Science wherever applied insists upon substituting objective judgment for prejudice, emotion, preconceived ideas or opinion based upon uncritically accepted data. Scientific method labors ever to refine conclusions and inferences by scrutinizing old data in order, if possible, to detect certain neglected aspects in the inferences based thereon; and it busies itself with the gathering of new data for the purpose of generating new hypotheses. It is ever loyal to truth but it distinguishes between truth as a procedure, a method of inquiry, and truth as a cherished conclusion. It is neither an arbitrary subject matter nor an arbitrary method, but rather as James says of metaphysics, "an unusually obstinate attempt to think clearly and consistently."

V. T. THAYER

REVIEWS

Address all communications relative to book reviews to Editor E. J. Ashbaugh, Miami University, Oxford, Ohio.

LORGE, IRVING. *Influence of Regularly Interpolated Time Intervals Upon Subsequent Learning.* Teachers College, Columbia University, Contributions to Education, No. 438, 1930. 57 pp.

Educators are aware that economy of learning facts or skills is furthered more under conditions of distributed, than of massed practice. Additional evidence has been needed, however, to determine whether in initial or in later stages of learning the succeeding intervals are cumulative (increasing, decreasing, or zero) in effect. "The specific problem of this study is to ascertain what differences in efficiency, if any, result at trials subsequent to each regular interpolation (insertion) of a constant time interval in a practice series."

The author's point of departure is the critical review of Snoddy's results and conclusions drawn from his study of groups who traced a maze, similar to the conventional mirror-drawing, under conditions of distributed and of massed practice. Different units of score—reciprocals of raw scores (Snoddy), raw scores (Lorge)—reveals trial 6 (Snoddy) and trial 2 (Lorge) as the trial beyond which the observed superiority of distributed over massed practice is diminished. From data similarly gathered with but slight change in the procedure Lorge concludes trial 3 to be that of maximum superiority. However, differing forms of averages were used — median and mean — as descriptive of data gathered by Snoddy and by Lorge, respectively. As the man and median differ in size for moderately asymmetrical distributions, the evidence favoring trial 3 versus trial 2 seems inconclusive. Since the author realized that either unit of score, "raw score" or its reciprocal, was an "indefinite mixture of amount produced per unit of time and quality of product," may it not seem that the "harmonic mean" might have been selected as the form of average most descriptive of the achievement of each group.

The superiority of distributed over massed practice in the learning of three additional functions — mirror reading, memorizing of nonsense numbers, practicing substitution code—was dependent upon the length of the interval inserted, as well as upon the function.

The materials used, the three groups studied, the conditions of practice (massed, distributed including constant intervals of one minute, of twenty-four hours), specific aspect of problem, the unit of score, the logically possible results, actual results presented both in a frequency table and frequency curves, and the technique employed to detect increments of superiority for either or both of the distributed over the massed practice groups—all were very carefully and comprehensively stated and delimited. The inclusion of the standard deviation of the means in the frequency tables seems, however, as neither conclusions nor interpretations were based upon this measure of variability.

Although the observed superiority diminishes in absolute amounts, the insertion of a constant interval is shown to have a consistent and beneficial effect. The evidence is comparison of the results of distributed and massed with a mixed practice group is clearly evident from trial 6 to trial 20, as is the increase in superiority of the distributed practice group.

Comparison of distributed (intervals of one minute, and of one day) practice groups is indicative that observed superiority (decreased, increased, irregular, and approaching zero for the four functions studied) is dependent upon the extent to which improvement is possible after initial learning, but it is not dependent upon the advantage accruing to distributed practice at trial 2.

Thus, the findings of this investigation are of distinct value to those who are students of these conditions of learning. Efficiency in learning is dependent upon conditions of distributed versus massed practice. The extent to which distributed practice can be of benefit depends not only upon the function practiced, but upon each interpolated interval. The effect of the successively interpolated intervals is cumulative up to that trial at which mastery or practically complete learning of facts or skill is achieved.

WINONA M. PERRY
University of Nebraska.

VINEYARD, JERRY V. *Student Participation in School Government.* New York: A. S. Barnes & Co., 1930. xiv + 104 pp.

POUND, OLIVIA. *Extra-Curricular Activities of High-School Girls.* New York: A. S. Barnes & Co., 1930. vii + 97 pp.

MCDONALD, MARGARET ANNE. *The Class Organization and Activities.* New York: A. S. Barnes & Co., 1931. xv + 134 pp.

MEYER, HAROLD D. *The School Club Program.* New York: A. S. Barnes & Co., 1931. x + 178 pp.

DRAPER, EDGAR MARION. *Intramural Athletic and Play Days.* New York: A. S. Barnes & Co., 1930. xii + 137 pp.

The Extra-Curricular Library, under the editorship of Prof. Harold D. Meyer, consists at the present time of about a dozen volumes, each devoted exclusively to a single type of student organization or to some other single aspect of the field of extra-curricular activities. School administrative officers as well as professors of sociology are included in the list of authors. The series is published in small, pocket-size editions of 100 to 150 pages each. In the following paragraphs a brief description will be given of the last five additions to the library.

Student Participation in School Government has six chapters dealing with the underlaying philosophy, inauguration of student government, simplified parliamentary procedure, practices, values and problems, and suggestions to sponsors.

Intramural Athletics and Play Days consists of eight chapters on the sources, the objectives, program of sports, organization, administration, the present status of intramural programs, the director, the girl's play day, and student leadership.

The School Club Program is divided into four parts. Organization and administration are considered in Part I. Five types of organizations including subject, vocational, recreational and aesthetic, physical efficiency, and civic clubs are studied in some detail in Part II. Twenty-eight supplementary agencies such as the Boy Scouts and the Drama League of America are described in Part III. Part IV is an appendix

describing "twelve practical aids to the club program."

The Class Organization and Activities treats a subject to which comparatively little consideration has been given in the professional literature heretofore. Organization and administration are discussed in Part I, a four-year class program in Part II, detailed descriptions of a large number of activities are given in Part III, and Appendices A and B contain descriptive materials from individual schools.

Extra-Curricular Activities of High-School Girls. In this work recognition is given to the preparation of girls for the increasing scope of women's civic activities. Careful attention is accorded to the several types of organizations which give expression to the special needs of girls in school including provisions for social relationships, physical fitness, leisure time, and vocational interests. The practices of many excellent schools are described in concrete terms.

Question-blanks were freely used in the collection of material for all but the last of the five volumes. Each includes a short selected bibliography. Throughout the entire series progressive views are set forth, and a special effort has been made to present extra-curricular activities in a favorable light and to give practical suggestions to principals and teachers.

PAUL W. TERRY
University of Alabama.

BOLTON, FREDERICK E. *Adolescent Education.* New York: The Macmillan Company, 1931, 506 pp.

It is perhaps no exaggeration to say that there is no other field of education concerning which more scientific knowledge is needed, and less is available, than in the field of adolescent education. There has been a dearth of scientific literature produced in this field during the past fifteen years.

This volume, by Professor Frederick E. Bolton will meet a long-felt need in this particular field. The educational world apparently has not fully recovered from the loss sustained by the departure of that remarkable student, teacher and educator to whose memory Professor Bolton has dedicated this book.

The author states that the book is intended to be analysis and inventory of the adolescent for the purpose of finding his potentialities and his needs as determined by his unfoldment. The course of study is treated only incidentally and only as a means to an end. The author tells us that business, social and economic conditions, and traditions have been the educational determinants, and that the educational theorist, not trained in psychological analysis proceeds with what he conceives to be the logical unfoldment of the subjects and arranges the traditional school subjects into what he conceives to be ideal "mental discipline."

The child psychologist, instead of securing his basic information from industries and the world at large, endeavors to secure his information directly from the children. This procedure consists, perhaps first of all, of a thorough scientific analysis of the child's physical equipment, accompanied by a thorough and scientific analysis of his instinctive tendencies, his mental equipment, and his interests all of which serve as a key to the kinds of activity best suited to the proper development of the child.

Professor Bolton points out the often unobserved fact that a scientific education procedure builds upon what *is*, in order to achieve what is to be. This necessitates a scientific and functional knowledge of the preadolescent, adoles-

cent and the post adolescent life of the child. Professor Bolton's book consists of sixteen chapters, each giving a scientific treatment of a fundamental aspect of adolescent education. The book reveals a mastery of the scientific literature in the field of adolescent education. It is a most valuable contribution to this field of education. Each chapter is accompanied by a carefully selected bibliography. The book concludes with thorough and enlightening treatment of the ever present and gigantic problem of Character Education.

DENNIS C. TROTH
Pennsylvania State College.

MABIE, ETHEL. *Language Development in Primary Grades Through School Activities.* Bloomington, Illinois: Public School Publishing Company, 1930. 95 pp.

This book is a brief, practical guide in language methods and materials for primary grades. The author's viewpoint is decidedly social. She believes that language is not an isolated school subject, but is an outgrowth of group activities in which we must recognize personality problems. Expression demands sensitiveness to the personalities of the other members of the group. Content is more important than form; desire for expression is greater than the teacher's commands.

The weakness of the book lies in the lack of gradation of the activity units. In Grade One are suggested five units: A Reading Party, A Flower Show, A Study of Weight and Height, Indians of the Southwest, and An Excursion. With the exception of Indians of the Southwest, these units could be used in any primary grade. Indians of the Southwest could be used more profitably in Grade Three than in Grade One.

This weakness is overshadowed by the strength found in the clear cut lists of objectives. The author has deviated from the usual four column scheme of psychological analysis: namely, knowledge, habits or skills, judgment and ideals or attitudes. She has combined knowledge and skills into "Language Skills," or direct objectives; and judgment and attitudes into "Personality Development," or indirect objectives. Personality growth seems to be uppermost in her mind.

MARY WILLCOCKSON
Miami University.

SHARP, LLOYD BURGESS. *Education and the Summer Camp.* New York: Columbia University, 1930. 114 pp.

Dr. Lloyd Burgess Sharp, author of *Education and the Summer Camp, an Experiment*, presents a very interesting history of the development of the camping movement as it relates itself to the social service groups of New York City. He states very frankly in his introduction that he has taken the "best practices of the Boy Scouts of America, the Girl Scouts of America, the Young Men's Christian Association and the Camp Directors' Association in formulating the plan of organization and program of activities."

Dr. Sharp has brought his entire camping situation into line with tested educational processes and sound administrative procedure. As one studies the outcomes of this experiment, he cannot help but be impressed with the tremendous contribution that this study will undoubtedly make to the Social Welfare Camps of America when those in charge of such camps recognize the necessity of providing for all of the needs of boys and girls upon a progressive educational basis.

HARRY A. SPYKER
Y. M. C. A., Columbus, Ohio.

HILL, ADELENE B., AND VAN ALSTYNE, DOROTHY. *Learning Levels of the Children in the Nursery School: The Eating Situation.* New York: Columbia University, 1930. v + 41 pp.

Young children are confronted by many problems while they are acquiring bodily controls. Adults, for the most part, have forgotten the many more or less difficult processes which must be learned before the daily routine situations of life are mastered.

In this study an analysis is made of the learning levels of pre-school children. The age range is from eighteen months to four years. The eating situation is selected because "the eating situation reflects the problem of the whole nursery school day. For example, the child who continues to dawdle at dinner time, will usually be found to have the habit of dawdling under other conditions." A careful analysis of the eating situation is made including the motor, mental, social, and emotional aspects. The responsibilities of the child and of the teacher are stated for each step in acquiring a particular control. Some of the situations analyzed are: going to the table; putting on bib; using spoon or fork; drinking milk or orange juice; food likes and dislikes; taking care of spilled food; social reactions, as being friendly, etc.

The study is a distinct contribution in the field of the education of young children. It is based upon scientific study, not upon objective opinion. One of the outstanding values is the care the authors take to safeguard children, in the use of the study by mothers and teachers, from overstimulation and from being forced from one learning level to another. The study will be of service to mothers, teachers of young children, hospital nurses, and social workers, in guiding children from one developmental level to another.

CONSTANCE T. MACLEOD
Ohio University.

RESEARCH ABSTRACTS and BIBLIOGRAPHIES

Address all communications relative to research abstracts and bibliographies to Editor A. S. Barr, University of Wisconsin, Madison, Wisconsin.

BULLETINS

BENZ, H. E. "The Learning and Teaching of Algebra," *Report of the Every Pupil Test in Algebra*, December 2, 1930. Conducted by the State Department of Education, Columbus, Ohio.

A report of the Every Pupil Test for December 2, 1930, giving a summary of results, analysis of errors, suggestions for improving instruction, and a bibliography.

Bulletin of the American Child Health Association, Reprinted from the *Child Health Bulletin*, March, 1930. 370 Seventh Avenue, New York City: American Child Health Association.

Contains two articles, one by Anne Whitney on "Weighing School Children," and one by George Truman Palmer on "Nutritional Status Measurement."

COLE, ROBERT D. "Educational Achievement in North Dakota City, Town, and Rural Schools," *Departmental Bulletin of the University of North Dakota*, XV (April, 1931), 53 pp.

The author presents tabular and graphical materials relating to the educational achievement in North Dakota city, town, and rural schools.

COXE, WARREN W., AND COWEN, PHILIP A. "Educational Needs of Pupils in Small High Schools," *University of the State of New York Bulletin*, No. 969 (April 1, 1931), 63 pp.

Discusses the communities in small high schools: community organization, population, activities, and occupations; the small high school: subject matter offered, holding power; the pupils of the small high school: occupation choices, etc.

Every Pupil Test, Conducted by the State Department of Education, Columbus, Ohio, December 2, 1930, 55 pp.

A report of the Every Pupil testing program carried on by the Ohio State Department of Education.

GIFFORD, W. J. "Report of Committee on Research and Service," *Association of Virginia Colleges*, Address delivered at the Annual Meeting held in the Jefferson Hotel, Richmond, Virginia, February 13-14, 1931, pp. 11-15.

A report of research investigations made by members of the Association of Virginia Colleges, listing the name of the instructor, title of the study, and probable date of completion.

GREGG, RUSSELL T., AND HAMILTON, THOMAS T., JR. "Annotated Bibliography of Graduate Theses in Education at the University of Illinois," *Bureau of Educational Research Bulletin*, No. 55 (University of Illinois, 1931), 80 pp.

An annotated bibliography of 252 graduate theses in Education at the University of Illinois.

KUHN, EFFIE G., AND OTHERS "The Assembly in the Teachers College," *Trenton Studies in Education*, No. 1 (State Teachers College, Trenton, New Jersey, March, 1931), 22 pp.

A report upon a questionnaire investigation of the uses made of the school assembly.

OSBURN, W. J., AND FOLTZ, P. J. "Permanence of Improvement in the Fundamentals of Arithmetic," *Educational Research Bulletin*, Ohio State University, X (April 29, 1931), 227-234.

From the use of the Wisconsin Inventory Tests given in October, April, and September, the author concludes that there was a large amount of improvement from October to April, and that the average amount of time lost from April to September ranged from three-fifths to less than one-twelfth of the amount of gain shown in the April tests. The greatest losses were in subject matter taught for the first time. The brighter pupils showed the largest amount of gain and the smallest amount of loss, while the amount of gain made by the slower pupils was less and the proportional loss greatest.

ROSS, C. C., AND GARD, PAUL D. "Two Modified Methods of Administering Two Standardized Group Intelligence Tests," *Bulletin of the Bureau of School Service*, College of Education, University of Kentucky, II (June, 1930), 115 pp.

A study of the relative value of two modified methods of administering Terman's Group Test of Mental Ability, Form A and Form B, and Otis's Self-Administering Test of Mental Ability, Intermediate Examination, Form A and Form B.

SCRUGGS, SHERMAN P. "Improving Reading Ability in Grades V and VI by Extensive Reading," *Bulletin of Education*, (University of Kansas, April, 1931), 3-8.

The report of the amount of improvement in rate and comprehension in the reading activities of a group of negro pupils by exposing them to a reading environment and permitting them to read extensively from materials interesting to them.

TOUTON, FRANK C. "Abstracts of Unpublished Masters' Theses in the Field of Secondary-School Administration," *Bulletin of the Department of Secondary-School Principals of the National Education Association*, No. 36 (April, 1931), 67 pp.

Contains abstracts of theses relating to problems in business and vocational training, part-time education, methods of teaching and testing secondary-school pupils, library administration, records and reports, supervision of attendance and tardiness, extra-curricular activities, publicity, and miscellaneous studies.

TYLER, RALPH W. "A Generalized Technique for Constructing Achievement Tests," *Educational Research Bulletin*, Ohio State University, X (April 15, 1931), 199-208.

The author sets forth a series of steps to be followed in the construction of achievement tests.

EDUCATIONAL ADMINISTRATION AND SUPERVISION

CONVERSE, PAUL D. "Time-Studies in the University," *Journal of Higher Education*, II (May, 1931), 258-262.

Illustrates the application of time studies to various phases of student activities in universities.

GERBERICH, J. R., AND PRALL, C. E. "Departmental Organization versus Traditional Organization in the Intermediate Grades," *Elementary School Journal*, XXXI (May, 1931), 671-677.

The author concludes that the general feeling that pupils in the lower grades are less likely to profit from the departmental organization than those in the upper grades is not supported by his data.

THE PSYCHOLOGY OF LEARNING

CARROLL, HERBERT A. "The Effect of Intelligence upon Phonetic Generalization," *Journal of Applied Psychology*, XV (April, 1931), 168-181.

An experimental study from which the author concludes that bright pupils are much more likely than dull pupils to err phonetically, and that the explanation of these differences appears to lie in the marked superiority of the bright over the dull in phonetic generalization ability.

EASLEY, HOWARD. "An Attempt to Isolate the Factor of 'Attention'," *American Journal of Psychology*, XLIII (April, 1931), 202-215.

The author studies the intercorrelations between a number of measures of attention, from which he concludes that there is little or no relationship.

HOLLINGWORTH, H. L. "Effect and Affect in Learning," *Psychological Review*, XXXVIII (March, 1931), 153-159.

A critical discussion of the "law of effect."

LIDE, EDWIN S. "The Social Composition of the Secondary-School Population in Oklahoma," *School Review*, XXXIX (May, 1931), 350-360.

A study of the social composition of the secondary-school population in Oklahoma, following the lines of Counts's study of the selective character of American secondary education.

EXPERIMENTAL STUDIES OF TEACHING

GATES, ARTHUR I., PEARDON, CELESTE COMEGYS, AND SARTORIUS, INA CRAIG. "Studies of Children's Interests in Reading," *Elementary School Journal*, XXXI (May, 1931), 656-670.

An article reporting the main findings and conclusions of some sixteen separate investigations of the interest in reading material of children in the first three grades, conducted by the writer and his assistants.

GRAY, WILLIAM SCOTT. "Summary of Reading Investigations (July 1, 1929, to June 30, 1930.) II," *Elementary School Journal*, XXXI (April, 1931), 592-606.

Part II of Gray's Summary of reading investigations, July 1, 1929, to June 30, 1930.

HOLMES, ELEANOR. "Reading Guided by Questions versus Careful Reading and Re-Reading Without Questions," *School Review*, XXXIX (May, 1931), 361-371.

An experimental study from which the author concludes that reading guided by questions surpasses careful reading and re-reading without questions.

EDUCATIONAL TESTS AND MEASUREMENTS

BLACKBURN, J. M. "Individual Differences in the Performance of a Simple Test," *British Journal of Psychology* (General Section), XXI (April, 1931), 385-393.

The purpose of this paper is to show the large range of individual variation that can occur in the performance of a comparatively simple test. The author indicates the difficulties involved in attempting to attain a purely objective measurement.

DAVIS, ROBERT A., AND JOHNSON, L. W. "The Influence of Intelligence upon Performance in New-Type and Old-Type Examinations," *Educational Method*, X (May, 1931), 488-493.

The authors find that the average marks made in new-type examinations are higher at every intelligence level than those made in the old-type, and that pupils perform more in accordance with their respective levels of ability in new-type examinations than in old-type examinations.

EURICH, ALVIN C. "Four Types of Examinations Compared and Evaluated," *Journal of Educational Psychology*, XXII (April, 1931,) 268-278.

A comparison of the essay, completion, multiple-choice, and true-false types of examination. The completion and multiple-choice tests proved to be most reliable. If the composite score of three types of examinations is used as the criterion for estimating the validity of the fourth, the results indicate that the four types of test have approximately equal validity.

NEWCOMB, THEODORE. "An Experiment Designed to Test the Validity of a Rating Technique," *Journal of Educational Psychology*, XXII (April, 1931), 279-289.

A statistical study of the validity of a rating technique applied to human behavior.

SHANNON, J. R. "A Performance Test in General Methods of High-School Teaching," *Teachers College Journal*, XX (May, 1931), 139-143, 160.

The author offers certain statistical data relating to the validity and reliability of a performance test in general methods of high-school teaching.

SIMS, V. M. "Converting Test Scores to Percentage Grades," *School and Society*, XXXIII (May 2, 1931), 596-598.

The author presents a method of translating test scores into percentages grades.

THURSTONE, L. L., AND THURSTONE, THELMA GWINN. "The 1930 Psychological Examination," *Educational Record*, XII (April, 1931), 160-178.

A report of norms for the 1930 edition (7th edition) of the American Council on Education Psychological Examination.

WHELDEN, C. H., JR., AND DAVIES, F. J. J. "A Method for Judging the Discrimination of Individual Questions on True-False Examinations," *Journal of Educational Psychology*, XXII (April, 1931), 290-306.

The authors outline a procedure tested in the Yale Law School for judging the discrimination of individual questions on true-false examinations.

STATISTICS

CRATHORNE, ARTHUR R. "Principles of Statistical Methodology," *Journal of the American Statistical Association*, XXVI (March, 1931), 27-32.

A discussion of the mathematical foundations of the methodology of statistics.

HOTELLING, HAROLD. "Recent Improvements in Statistical Inference," *Journal of the American Statistical Association*, XXVI (March, 1931), 79-87.

A brief resumé of recent advances in statistics, particularly with reference to improvements in statistical inference.

IRWIN, J. O. "Mathematical Theorems Involved in the Analysis of Variance," *Journal of the Royal Statistical Society*, XCIV, Part II, (1931), 284-300.

A paper giving the essential theorems involved in the analysis of variants proposed by R. A. Fisher.

KELLEY, TRUMAN L. "Statistical Methods Applied to Psychological Problems," *Journal of American Statistical Association*, XXVI (March, 1931), 164-167.

A brief discussion of the application of statistical methods to psychology.

MAY, MARK A. "Statistical Methods in Personality Studies: Reliability," *Journal of the American Statistical Association*, XXVI (March, 1931), 168-174.

A discussion of reliability formulae developed by May in personality studies.

PRAK, J. L. "An Empirical Research on the Reliability of Correlation Coefficients," *British Journal of Psychology* (General Section), XXI (April, 1931), 394-403.

The author concludes that the formula for the probable error actually holds, although groups of 30 and 20 persons give a more favorable result than groups of 15, 10, and 6.

WRIGHT, SEWALL. "Statistical Methods in Biology," *Journal of American Statistical Association*, XXVI (March, 1931), 155-163.

The author points to specific applications of statistics in biology and concludes that the statistical and experimental methods should supplement each other in this field.

NEW TESTS

Classroom Growth Record. 370 Seventh Avenue, New York City: American Child Health Association, 1931.

A wall chart to encourage the educational use of weighing and measuring.

HURD, A. W. *Final Test in High-School Physics.* New York City: Bureau of Publications, Teachers College, Columbia University, 1930.

LEONARD, J. PAUL. *Leonard Diagnostic Test in Punctuation and Capitalization.* Yonkers-on-Hudson, New York: World Book Company, 1931.

ODELL, C. W. *Standard Achievement Test on Educational Measurement.* Bloomington, Illinois: Public School Publishing Company, 1931

OSBURN, WORTH J. *Wisconsin Inventory Arithmetic Tests.* Bloomington, Illinois: Public School Publishing Company, 1931.

There are now four additional Inventory Tests in Arithmetic:

Test IX, Bridging in the Addition of Mixed Numbers;

Test X, Bridging in the Subtraction of Mixed Numbers;

Test XI, Problem Solving for Grades 3, 4, and 5;

Test XII, Denominate Numbers.

OTIS, ARTHUR S., AND ORLEANS, J. S. *Standard Graduation Examination for Elementary Schools.* Yonkers-on-Hudson, New York: World Book Company, 1931.

A comprehensive objective test for use as a final examination in all subjects for pupils completing the elementary school (in either eight-grade or seven-grade systems).

WEBER, JOSEPH J. ***Standard Achievement Test on Aims, Purposes, Objectives, Attributes, and Functions in Secondary Education.*** Bloomington, Illinois: Public School Publishing Company, 1931.

WIEDEFELD, M. THERESA, AND WALTHER, E. CURT. *Wiedefeld-Walther Geography Test.* Yonkers-on-Hudson, New York: World Book Company, 1931.

OSBURN, WORTH J. *Wisconsin Inventory Tests in Arithmetic.* Bloomington, Illinois: Public School Publishing Company, 1931.

Tests IX to XII have been added to this series of tests.

TORGERSON, T. L. *Public School Achievement Tests,* Forms 3 and 4, Batteries B and C. Bloomington, Illinois: Public School Publishing Company, 1931.

Battery A (described in the November, 1930, *Journal of Educational Research*) was used in Project I; Batteries B and C, in Project II, of the Seventh Annual Nation-Wide Testing Program.

Battery B includes:

(a) *Grammar:* Covers sentence form and parts, parts of speech, phrases and clauses, tense, and the use of nouns and pronouns in sentences.

(b) *History:* Covers the several periods of American history, from the period of exploration to the present time.

(c) *Geography:* Measures the ability to read and interpret a map in addition to measuring important geographical information.

Battery C includes:

(a) *Nature Study:* Measures knowledge of important information concerning nature study.

(b) *Health:* The items deal largely with functional information in hygiene and health.

MISCELLANEOUS

STECKEL, MINNIE LOUISE. "Parental Age and Intelligence of Offspring," *Journal of Educational Psychology,* XXII (March, 1931), 212-220.

The author shows that children born of very young parents are less intelligent than children of more mature parents.

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A summary of investigations relating to reading published between July 1, 1929, and June 30, 1930.

RESEARCH NEWS and COMMUNICATIONS

Address all research news and communications to Editor Carter V. Good, Teachers College, University of Cincinnati, Cincinnati, Ohio.

National Survey of School Finance.—A four-year national survey of the school tax dollar will begin on July 1. Paul R. Mort of Teachers College, Columbia University, is Associate Director of the survey in active charge of the study and William John Cooper, United States Commissioner of Education, is director of the survey. Congress authorized the National Survey of School Finance to be made at a cost not to exceed $350,000. For the fiscal year beginning July 1, 1931, $50,000 has been made available. It is expected that $100,000 per year will be appropriated for the following three years.

Expenditures for public elementary, secondary, and higher education in the United States now total $2,450,000,000 annually. The survey is expected to produce comparative information on sources and uses of these funds in order to satisfy the demand by state legislatures, school officers, and school boards for authoritative data. Although statistics on school finance have been collected by the Office of Education since its creation in 1867, variations of accounting, assessment of properties, and kinds of taxes levied in states and cities have given rise to many puzzling questions which can be answered only by such a survey as that now planned.

Professor Mort will be assisted in the making of the survey by a temporary staff of tax experts and specialists in school finance who will be recruited from the colleges and from state finance and education departments. He will also be assisted by a board of expert consultants and advisory committees, members of which will be named by the Secretary of the Interior.

Authorization for a national survey of school finance was recommended to Congress by Commissioner Cooper when recent investigations revealed that finance is the outstanding school problem before state legislatures and state school officials. Eighty-six percent of the school-legislation bills in the states during the last two years dealt with one aspect or another of school finance. Investigation of school finance was urged by the National Education Association, the National Council of State Superintendents and Commissioners of Education, and other educational organizations as the next national educational survey to be conducted by the Office of Education.

This will be the third national survey conducted by the Office of Education. The National Survey of Secondary Education (high schools) will enter its third and final year beginning July 1. The National Survey of the Education of Teachers is completing its first year of work and is now receiving questionnaires answered by more than half a million American public-school teachers. The findings of these national surveys will consist of an orderly organization of the statistics and information collected, virtually an inventory of some particular phase of American education. When the

findings are available, the Commissioner of Education will welcome invitations from leading universities and educational organizations to call conferences of field-workers, college professors, deans of education, and administrators concerned with the particular phase of education studied. Numerous invitations have already been received to hold conferences on secondary education at the conclusion of the secondary-education survey. Findings of the national studies will be used at these regional conferences by local educators to re-examine their local problems and progress in light of the new data.

Projects of the National Survey of the Education of Teachers.—The studies which are engaging the attention of the National Survey of the Education of Teachers under the direction of the United States Office of Education and E. S. Evenden of Columbia University with the authorization of Congress are as follows:

1. A study of supply and demand and adequacy of preparation. This study has involved sending a short data-blank to every teacher and professional worker in the public-school systems of the United States, nearly a million persons in all. Considerable time and effort have been spent in confining this blank to essential facts only and in devising a form which is answered easily and from which the facts can be transferred economically to Hollerith cards. These blanks have been distributed and are being returned to the Survey office. It is hoped that they will provide not only a census account of the various types of workers in the several fields of education but also interesting and valuable data on such items as: type of schools in which the teachers were prepared, amount of professional training, number of different positions held, reasons for turn-over during the last year, and sources of supply for different types of teachers. It is hoped that through these questions additional light may be thrown on a number of controversial issues, even though the results will not completely solve the problem.

2. The preparation of data blanks and of the necessary means for studying the faculties of teachers colleges and other higher educational institutions whose graduates are going into teaching. This study will be made one of the principal pieces of work for the second year of the Survey.

3. An intensive study of curriculums for the professional preparation of different kinds of teachers in various types of institutions is now being organized under the supervision of Earle Rugg of the State Teachers College at Greeley, Colorado, and W. E. Peik of the University of Minnesota. These studies will include a very careful analysis of curriculums for preparing teachers in terms of: length, prescribed subjects, required sequences, arrangement into majors and minors, place and amount of observation and practice teaching, percentage of the courses devoted to education, and similar questions which annually are confronting administrative officers and faculty committees working on curricular problems. This study also will include a canvass of the work that is being done at the graduate level for the preparation of teachers.

4. The National Survey is coöperating with the N. E. A. in its investigation of teacher supply and demand and certification practices as shown by the records of state departments of education. This study is being made by Frank Hubbard of the N. E. A. in coöperation with the Survey.

5. A very detailed annotated bibliography on the preparation of teachers is

being prepared by Gilbert L. Betts of the Survey staff who also will work on the perfection of instruments for the rating and measurement of teaching success.

6. The National Survey is coöperating with Douglas Waples of the Graduate School of Library Service, University of Chicago, in an analysis of the reading interests of teachers and in an analysis of the professional adequacy of the libraries of teachers colleges. The latter study also is being sponsored by the American Library Association and the North Central Association. As a result of this investigation, it is hoped that very accurate comparisons between the adequacy of the libraries of different types of teacher-training colleges can be made.

7. A detailed study is being organized for an analysis and study of the various programs for in-service education of teachers. This study is to be made by Ned H. Dearborn of New York University, who is director of the extension work of that institution.

8. Tests are being developed under the direction of R. B. Raup of Columbia University by means of which it is hoped to discover the prevailing philosophies of education in the different types of institutions now preparing teachers.

9. A detailed history of the education of teachers from the beginning of this country to the present time is being prepared by Benjamin W. Frazier, administrative assistant for the Survey.

Results of the Missouri Survey.—Following the recommendations made in the report of the survey of the schools of Missouri by the Division of Field Studies, Teachers College, Columbia University, there has been enacted the most constructive piece of school legislation since the establishment of free public schools in that state. The essential features of the recent law signed by Governor Caulfield are as follows:

1. An eight-months term is guaranteed to all districts.
2. Each pupil is guaranteed eight years of elementary and four years of high-school training.
3. The entire state will be re-districted into optional enlarged school districts by a county board of education in each county. Each proposed school district must contain fifty square miles of territory or have in lieu thereof an assessed valuation of $1,500,000.
4. Each elementary teaching unit is guaranteed $750 and each high-school teaching unit, $1000 for current expenses on a local level of two mills.
5. Free high-school tuition is provided for all rural boys and girls; the state will pay $50 per pupil and the local district will pay the remainder.
6. State aid for transportation is provided to the amount of $3.00 per month for each child transported a distance of two miles or more.
7. When any enlarged school district builds a new building, the state will pay toward the cost of said building $1000 for each one-room rural school abandoned.
8. Free textbooks for all children in the elementary school are provided.
9. The state school fund is increased from five million to eight and one-half million dollars per year. The eight and one-half million will be apportioned as follows: about two and one-half millions will be spent for transportation, high school tuition, and state aid to the wealthy districts above the minimum guarantee; the remainder will be used

as an equalizing fund to bring all districts up to the minimum standard.

10. Additional money is being secured from a graduated state income tax of one to four percent.

The report on the survey was made in the fall of 1929. The survey report was approved by the State Survey Commission of which Theodore Gary was chairman. Members of this Commission heartily supported the survey recommendations before the Legislature. The report also received the professional support of schoolmen and women throughout the state to whom should be given much of the credit for this constructive legislation.

Research Division of the N.E.A.—Recent activities of the Research Division of the National Education Association include several projects of interest. Four publications have appeared between March 1, 1931, and May 1, 1931.

1. "The Principal at Work on His Problems," *Research Bulletin*, Vol. IX, No. 2, March, 1931. This study is an enlarged and completely revised edition of "The Principal Studies His Job," a *Research Bulletin* published in March, 1928. The principal is discussed from four viewpoints: (1) as a person, (2) as head of a single school unit, (3) as a worker in a school system, and (4) as an active participant in a professional group. The various chapters summarize current viewpoints, practice, and research. The bulletin was planned to help school executives study their problems and obtain a clearer conception of their work.
2. "Flat-Rate and Percent-of-Salary Retirement Systems" is published as Study No. 7 in the series of *Studies in State Educational Administration*. It contrasts the two plans of statewide teacher retirement systems as to theoretical efficiency, practical operation, history, and present status.
3. "The Personal Income Tax and School Support" is published as Study No. 8 of the same series. It includes the historical development of state income tax legislation, the effectiveness of the personal income tax, and present practice regarding it as a source of school revenue.
4. "Staffs and Salaries in State Departments of Education" is issued as Study No. 9 of the same series. This study presents information on the salaries paid state school officers and on certain other related aspects of their work. It is based on information supplied by the departments of education in forty-seven states and two territories, supplemented by previous studies in the same field.

The Research Division has coöperated in an editorial and a consultative capacity with regard to the publications of three departments of the National Education Association:

1. The *Tenth Yearbook* of the Department of Elementary School Principals has been issued as the April number of the Bulletin of this Department. It has the title, "The Principal and Supervision," and stresses the point that supervision is a coöperative endeavor which calls for a high type of personal enthusiasm, mutual good will, and professional skill. It may be used as a handbook, not only for principals in service, but also for the training of future school leaders.

2. "Teacher Personnel" is the subject of the April number of the *Review of Educational Research*. This is the second issue of the review, which is published by the American Educational Research Association, a department of the National Education Association. A bibliography accompanies each chapter.
3. *What Are the Major Objectives of Education?* is the title of a pamphlet prepared for the National Council of Education. It contains statements of the outcomes which educational leaders at different periods have hoped might be realized through education.

Since 1924, the Research Division has coöperated with the Department of Superintendence in maintaining the Educational Research Service. Subscription to the service includes circulars dealing with topics selected on the basis of subscribers' interests.

"Size of Class in 47 Cities over 100,000 in Population" is issued as *Circular* No. 1, 1931, of the Educational Research Service. This study summarizes the replies of cities above 100,000 in population to a questionnaire issued October 27, 1930, to 406 city school systems. Similar reports will follow on cities below 100,000. Other circulars for 1931 are: "Education in Lay Magazines," *Circulars* No. 2 and 5, each a bimonthly review of articles on education in current non-professional magazines; "Preliminary Figures on Classroom Teachers' Salaries, 1930-31, in 86 Large Cities"; *Circular* No. 3, which shows in a 6-page tabulation minimum, maximum, and median salaries for teachers in cities over 100,000 in population; and "Transportation of School Children in 67 Large City School Systems," *Circular* No. 4, a tabulation of facts collected by the Bureau of Educational Research in the Baltimore public schools.

Increase in Research Bureaus.—American city school systems rapidly are introducing research bureaus, Edith A. Wright, member of the library staff of the Federal Office of Education, points out in a statistical survey recently published. Within the last six years, the number of bureaus has increased from 50 to 118. Additional information from the survey follows:

The majority of the cities place testing as the first function of the bureau. Testing involves research in tests and measurements, psychological measurements, testing and guidance, tests and examinations, and similar curriculum practices. In 112 cities, this function ranks first. In 93 cities, the first function of the research bureau is devoted to the improvement of instruction, while surveys rank first in 88 others. The other functions of these bureaus include experimental studies, curriculum making, guidance, finance studies, child study, and statistics.

Research bureaus are divided among cities above 10,000 population as follows: 24 are in cities under 30,000; 12 are in cities from 30,000 to 50,000; 31 are in cities from 50,000 to 100,000, and 52 are in cities whose population exceeds 100,000.

Much variety exists in the names of the bureaus themselves. This probably is due to the nature of the chief functions with which each is concerned. Some are called bureau of curriculum; others, bureau of research; while still others are called department of testing.

Statistics and Research in Pennsylvania.—The increasing number of requests for accurate and complete figures pertaining to educational affairs in the commonwealth, together with the regular service maintained in the office of statistics, research, and reports, has demanded the full-time service of a director and a clerical personnel of some fifteen

assistants throughout the biennium ending May 31, 1930. The director of the Pennsylvania State Department of Statistics, Research, and Reports is Jonas E. Wagner. The major activities of the office during this period were organized with reference to a general statistical service, the development of coöperative and other types of educational research, the editing of all reports and bulletins issued by the Department, and, during the past year, the setting up of a sort of clearing-house for the answering of all questionnaires of a general nature.

First, the statistical service covered the following major activities:

a. The preparation of the two volumes of the Annual Statistical Report of the Superintendent of Public Instruction. It is believed that the information found in these reports is organized in such a way that school officers, research workers, and others interested in public education will find it possible to secure from the tabular material sufficient data to make an analysis of the progress of education in Pennsylvania.
b. The prosecution of a monthly service to county and district superintendents covering attendance data for practically all of the public schools of the commonwealth.
c. The preparation of statistical material requested by many public and private agencies and individuals interested in the different phases of a state's educational program. The demand for this is practically constant.
d. The preparation of all statistical reports and data for Pennsylvania for the United States Office of Education.
e. An almost continuous service in connection with the two Commissions appointed by the Governor to study the distribution of subsidies to school districts.

Second, the field of research has, perhaps, shown the greatest development during the last two years of any of the activities of this office. An increasing number of graduate students are utilizing the facilities offered to work out their theses. From eight to ten of such theses are constantly in process of completion. A full equipment of tabulating machinery and opportunity for access to the general files of the Department, covering educational data as far in the past as reported, offer a rich field for a coöperative service in connection with those who are pursuing graduate studies. In addition, the number of Department studies as the bases for the determination of policies, the collaboration with outside research agencies in the prosecution of sundry investigations, and the many studies of a minor nature that are constantly being made, indicate the scope of the work attempted.

Third, the responsibility for the editing of all Department reports and bulletins has been assigned to this office during the two-year period.

Fourth, during the same period, this office also has been designated the clearing-house for all questionnaires other than those in a specific field. The almost constant stream of such requests and the complex character of many of them impose one of the heaviest demands on the office force.

Information of a statistical nature to be of value must be accurate and deal with present situations. While much improvement is observed in the general character of the reports submitted by the respective educational agencies, and in the promptness of filing, inaccuracies are still too prevalent. Continued improvement along these lines would do much to de-

velop a statistical service in education that compares favorably with the high standards demanded for a similar service in the business world.

The Chicago Institute on Higher Education.—The Sixth Annual Institute for Administrative Officers of Higher Institutions will be held at the University of Chicago on July 8-10. The central theme of the Institute will be "Recent Trends in American College Education." The programs deal with the following problems: July 8, progressive reforms at the junior-college level; July 9, similar reforms at the senior-college level; and July 10, improved types of college tests and comprehensive examinations.

The University extends a most cordial invitation to administrative officers of all higher institutions, including liberal arts colleges, teachers colleges, and universities, to attend. Arrangements have been made for those who attend the Institute to visit classes and to enjoy other University privileges without the payment of fees. Letters of inquiry should be addressed to William S. Gray, School of Education, University of Chicago.

New York Research Conference.—The New York State Education Department invited college, university, and public-school people who are concerned with problems of educational research to attend a conference in Albany on March 27, 1931. About fifty people were present representing practically every institution of higher learning in New York State whose work involves such problems, as well as representatives of a number of city research bureaus. The conference was held in two sessions. In the first, state department people presented their pressing problems, and in the second, college representatives discussed problems in several broad fields.

The various speakers were Frank P. Graves, Commissioner of Education; Warren W. Coxe, Director of the Educational Research Division; R. H. Jordan, Cornell University; Harry P. Smith, Syracuse University and Syracuse Public Schools; Oscar E. Hertzberg, State Teachers College, Buffalo; Earle B. South, State College for Teachers, Albany; Frederic M. Thrasher, New York University; and Paul V. West, New York University. At the close of the conference, George D. Strayer, Teachers College, Columbia University, moved that the Commissioner of Education appoint a committee of five to confer with the State Director of Research and other members of the State Education Department concerning the problems presented. The motion was unanimously carried. A mimeographed list of 176 problems was distributed which previously had been submitted by those who attended, ninety-six coming from college and public-school people and eighty, from the State Education Department. The significant feature of these problems is the very broad range of interests and thinking revealed. They indicate that, in virtually every phase of education, there are a number of important unsolved research problems. The proceedings of the conference are being mimeographed. These documents are a unique contribution to the field of educational research in New York State.

Educational Research in Scotland.—The Scottish Council for Research in Education was established in June, 1928. The second annual report, covering 1929-1930, describes the organization and activities of the Council which consists of thirty-two members selected from specified educational institutions and organizations. Its purposes are to initiate and control special investigations, to receive suggestions for research, to allocate problems to suit-

able investigators, wholly or partly to finance approved investigations, and to authorize publication of results and recommendations. Among the investigations reported are: development of achievement tests, organization of a curriculum appropriate for pupils twelve to fifteen years of age, attainments of secondary-school pupils, influence of environment on mentality, and individual differences in temperament.

Council on Education.—The fourteenth annual meeting of the American Council on Education was held at Washington, D. C., May 8 and 9. The Chairman was Director Charles H. Judd of the University of Chicago. Friday morning committee reports were made as follows: "Problems and Plans in Education," Chancellor S. P. Capen, University of Buffalo; "Personnel Methods," Dean H. E. Hawkes, Columbia University; "National Advisory Committee on Education," Director C. R. Mann, American Council on Education. Friday afternoon various aspects of the topic, "Whose Money and How Much for American Education?" were discussed by Vice President S. W. Smith, University of Michigan; President S. L. Omwake, Ursinus College; President H. J. Doermann, University of Toledo; Professor H. C. Morrison, University of Chicago; Marshall Olds, New York City; Vice President G. A. Brakeley, University of Pennsylvania; and Dr. Anson Phelps Stokes, Washington, D. C. Saturday morning addresses were given as follows: "Chairman's Address," Dr. C. H. Judd; "The Educational Finance Inquiry of the United States Office of Education," Hon. W. J. Cooper, Commissioner of Education; "The Coöperative Test Service of the American Council," Dean J. B. Johnston, University of Minnesota, and Director Ben D. Wood, Coöperative Test Service; "The National Advisory Committee on Education by Radio," Dr. Joy E. Morgan, National Education Association; "The National Council of the Inter-American Institute of Intellectual Coöperation," Dr. Stephen P. Duggan; and "The Chicago Plan," Dean Beardsley Ruml, University of Chicago.

Radio in Education.—The Director-General of the British Broadcasting Corporation, Sir John C. W. Reith, was in the United States during the month of May, to attend the first annual assembly of the National Advisory Council on Radio in Education which was held in New York at the New School for Social Research, May 21-23. Sir John, who has directed the British Broadcasting Corporation since its founding, delivered an address on "What Europe's Experience in Educational Broadcasting Can Offer to America."

Others who addressed the Assembly were Ray Lyman Wilbur, Secretary of the Interior; General Charles McK. Saltzman, Chairman of the Federal Radio Commission; Henry A. Bellows, Vice-President, Columbia Broadcasting System; Professor James T. Shotwell, Columbia University; Dr. A. N. Goldsmith, Vice-President of the Radio Corporation of America; Miss Belle Sherwin, National League of Women Voters; Professor W. C. Bagley, Columbia University and the American School of the Air; and Dr. R. A. Millikan, California Institute of Technology, President of the Council.

Plans of the National Advisory Council on Radio in Education for developing educational broadcasting in America were announced by Levering Tyson, director of the Council. Funds for the basic organization and maintenance for a minimum period of three years have been assured by John D. Rockefeller, Jr., and by the Carnegie Corporation of New York. The

central office of the Council in New York City will act as a clearing-house of information about educational broadcasting as facts become available. The purpose is to further the art of radio broadcasting in American education. There is assurance of the close coöperation not only of educational institutions and organizations, but of the broadcasting industry, through the national chain systems and through the efforts of individual stations. Both the National Broadcasting Company and the Columbia Broadcasting System have representatives in the active membership of the Council.

National Conference on Parent Education.—A national conference on parent education was held in coöperation with the National Congress of Parents and Teachers at Hot Springs, Arkansas, May 1 and 2, 1931. Representatives of colleges, universities, national welfare and educational associations, and United States Government agencies attending the conference grappled with the vital policy-determining problems upon which the practical work of thousands of parents and teachers depends. This was the first nation-wide meeting called by the Office of Education to bring together lay and professional agencies engaged in parent-education projects and promotion. Subjects discussed were: the changing backgrounds of home and family life, parent-education problems at different ages of children, professional training of leaders in parent education, and utilization of existing forces for parent education. Bess Goodykoontz, Assistant United States Commissioner of Education, presided at the conference.

Indiana Conference.—The Eighteenth Annual Conference on Educational Measurements was held at Indiana University April 24 and 25 and the Eighth Annual Conference on Elementary Supervision April 23. The theme of the conference on supervision was "The Social Studies in the Elementary School." The principal speaker of the two conferences was Harold Rugg of Columbia University.

Indiana Testing Program.—The four state higher institutions of Indiana (Ball State Teachers College, Indiana State Teachers College, Indiana University, and Purdue University) during the spring months conducted a state testing service to cover the curriculum of the senior high school in all of the major subjects offered. The high schools purchased approximately 90,000 tests and 8,000 pupil-rating scales. Responsibility for printing and distribution of the tests as well as analysis of results devolved upon H. H. Remmers and the Division of Educational Reference, Purdue University.

Oakland Studies.—The Department of Research of the Oakland, California, schools reports in five mimeographed bulletins the results of recent investigations: testing of 1958 eighth-grade pupils by the Terman Groups Test of Mental Ability; mental testing of 1682 third-grade pupils by the Kuhlman-Anderson Test; testing of 1496 first-grade pupils by the Detroit First Grade Intelligence Tests, the Park-Franzen Test of Readiness for Grade One, and the Pintner-Cunningham Primary Mental Tests; the holding power of the Oakland schools, 1930-1931; and an experiment in predicting success in first-year algebra in two junior high schools.

Testing at Antioch College.—Students of education frequently have occasion to question the merits of innovations which have not been subjected to quantitative and objective evaluation. The coöperative plan at Antioch, now near the end of its first decade, recently has been

evaluated by comparing the scores of Antioch students on certain tests with the performance of students in thirty-two Pennsylvania colleges.

In the spring of 1930, the Carnegie Foundation for the Advancement of Teaching gave a series of tests and examinations to students in thirty-two Pennsylvania liberal arts colleges for the purpose of evaluating their academic work. Antioch received permission to give the same examinations under similar conditions. In the Pennsylvania colleges, the examinations were given to students in the second year of the regular four-year college course, the students having had a total of about sixty-five weeks of college study. At Antioch, the examinations were given to students in the third year of the six-year course of alternating work-and-study, the students having had a total of about fifty-four weeks of college study. The average age of the Antioch students taking the examinations was twenty-one years and four months. Several types of examinations were given, the whole requiring the better part of a week of each student's time.

The first of these examinations was an intelligence test. In this, Antioch students ranked exactly with the highest of the thirty-two Pennsylvania colleges.

Second was an examination in "general culture," including foreign literature, fine arts, general history, and science. In this, Antioch ranked next to the highest of the Pennsylvania colleges.

The third rating was a "total score" which summed up in one grade the examinations in foreign literature, fine arts, general history, science, English, and mathematics. In this, also, Antioch ranked next to the highest Pennsylvania college, although only slightly higher than the second highest college.

Fourth was a series of examinations in individual college subjects. In these, Antioch ranked higher than this highest Pennsylvania college in biology, American history, government, economics, and chemistry. It ranked lower than this highest college in the languages (Latin, French, and German) and in physics.

These Carnegie tests included a professional examination for students majoring in the field of education. This examination was given to 1880 sophomores, juniors, and seniors in Pennsylvania colleges. Antioch gave this same examination to sub-juniors and seniors. More than one-half of the Antioch students ranked in the highest 3 percent of the Pennsylvania students.

The reader may be reminded that since Antioch students ranked with the highest of the Pennsylvania colleges in intelligence, they should be expected to do correspondingly well on achievement tests. Apparently the results reported in a mimeographed bulletin from Antioch do not differentiate between the contributions of intelligence and of training to the performance of students.

Minnesota Research.—Research projects completed recently at the University of Minnesota include Dora V. Smith's study of "Class Size in High-School English," which is devoted largely to the differences in teaching methods that were found successful in large and small classes respectively, and to the means of adapting teaching techniques to the size of the class; John E. Bohan's investigation of "Students' Marks in College Courses," which is a study of the discrepancies existing, under the present marking system, in marks awarded the same students in various college courses; and Victor H. Noll's study of "Laboratory Instruction in Inorganic Chemistry," which was carried on to discover the comparative value

of various amounts of laboratory work in elementary chemistry classes, and in an attempt to find a substitute for some portion of the laboratory work now considered necessary in such courses. These three studies have been published in book form by the University of Minnesota Press.

Ohio Testing Program.—On December 10, 1929, the first Ohio Every Pupil Test was administered. For the second test, held December 2, 1930, tests and accessories totaling 689,800 were ordered. The fields covered were chemistry, general science, physics, arithmetic, algebra, geometry, history, Latin, and English. The results are reported in recent bulletins of the State Department of Education at Columbus.

Carnegie Endowment for International Peace.—The Division of Intercourse and Education of the Carnegie Endowment for International Peace has completed twenty years of work. The director, Nicholas Murray Butler, president of Columbia University, outlines the accomplishments of the year in the annual report for 1930. In order to promote development of international understanding of people, institutions, languages, and cultures of various lands, the Division has made it possible for representative groups of scholars and teachers, editors and men of science, lawyers and men of affairs, and students of agriculture, economics, and architecture to gain a truly international experience and knowledge.

Guidance in Engineering Education.—Stevens Institute of Technology announces that its Engineering Camp in northern New Jersey will be used for two weeks this summer, August 15-29, as the scene of an experiment in vocational guidance for boys just completing the third year in their high-school or preparatory-school course. Principals and headmasters have been invited by the college to present the names of pupils who are interested in engineering. The college will open the camp to them and will provide a two weeks' program on the subject of the engineering profession and its functions.

The purpose is: (1) to give them a thoroughly good time in the open; (2) to tell them by lectures, posters, and movies what engineering, in general, is all about; (3) to give them some experience in a simple kind of engineering by a few hours a day of field work in elementary surveying; and (4) to give each boy individually the best guidance possible in choosing between an engineering and a liberal-arts college. Men actively engaged in engineering will be brought to camp to tell the boys about electrical, mechanical, civil, chemical, and industrial engineering; of what each consists and the types of work involved; what opportunities exist; and some of the problems with which an engineer is confronted.

Vocational Program for Porto Rico.—The benefits of the Federal vocational education and vocational rehabilitation legislation have been extended to Porto Rico. J. C. Wright, director of the Federal Board for Vocational Education, has just returned from a protracted visit to the Island, made at the request of Governor Franklin Roosevelt. The purpose of his visit was twofold: (1) to assist in preparing Insular legislation which would enable Porto Rico to accept the benefits of vocational education and vocational rehabilitation extended to it during the last session of Congress, and (2) to assist in formulating plans for organizing a vocational education and rehabilitation program.

Under the terms of the vocational education bill now pending in the Porto Rican legislature, there would be created an Insular Board for Vocational Education composed of the Commissioner of Education, as chairman and executive officer; the Commissioner of Agriculture and Industry; and the Commissioner of Labor. The bill provides for vocational education in agriculture, trade and industry, and home economics, and for a vocational rehabilitation service for persons disabled through accident, sickness, or congenital causes.

Rosenwald Fund Report, 1929-30.—The Julius Rosenwald Fund on June 30, 1930, completed the third year under its reorganization. Features of the year's activities were:

1. Coöperation in many aspects of Negro welfare, especially through aid to schools and colleges and through the provision of facilities for medical care and the protection of health.

2. Assistance in the organization of pay clinics and other means of distributing medical services at cost to persons of moderate means.

3. Gifts to a few experiments and demonstrations in general education and child development, to campaigns against illiteracy, and to the development of county library service.

4. Contributions to the study of social problems and the improvement of public administration.

5. During the year the Fund expended toward these purposes $1,875,655. In addition to these payments, pledges at the end of the year represented commitments for future years of an additional total of slightly more than five million dollars. It is thus evident that the trustees of the Fund are actively carrying out the instructions of the founder to spend both capital and income as promising opportunities are found.

Ohio State Intelligence Test.—In the recent intelligence-test survey of the high-school seniors of Ohio, more than 30,000 pupils participated. Form 17 of the O. S. U. Intelligence Test was administered. This test is scored by detaching the envelope on which the pupil writes his answers in multiple-choice form and by sending the flattened blank to the printer who with a zinc plate prints pink on the four wrong answers of each question, thereby eliminating entirely the usual eye strain involved in checking the wrong-answers portion of the scoring. After the blanks are returned from the printer the counting of right answers is very inexpensively done. For proposed use in next year's testing a form of self-scoring test has been devised wherein the pupil's paper is scored immediately. In other words, it is unnecessary to take the blanks to the printer for the scoring in pink, and the pupil himself may total his answers if desired. Pupils may exchange papers and count the answers twice independently with satisfactory results; or in any event the scoring is reduced so much that the teacher will not feel it an imposition to total the number of right answers. In this way pupils and teacher may have the results of the test within ten minutes after its completion, while interest is yet keen.

Plans are underway for development of a standardized form of test construction, similar to the Ford production method on automobiles. The test not only can be used repeatedly by replacing the test envelopes but by the standardized method of test construction the same envelope may be used interchangeably on two or more tests. By use of the new form not only will the scoring cost be reduced to a very small figure, but a given test blank may be used repeatedly so as to reduce correspondingly the test cost.

Kappa Delta Pi Award for Research.—Kappa Delta Pi, an honor society in education, announces a Research Study Series with a biennial award of one thousand dollars for the study adjudged most meritorious in a given field. The award for 1931-1932 will be given for the best report of research dealing with the problem, "Measurement of Efficiency in Teaching." A special committee will make the selection. The study which receives the award will be published by the Society in a monograph series complementing the present Kappa Delta Pi Lectureship Series. Manuscripts submitted for the 1931-1932 award should be in the hands of E. I. F. Williams of Heidelberg College, Tiffin, Ohio, by September 1, 1932. Announcement of the award will be made at the annual dinner of the Society, February, 1933.

Record of Current Publications—Leading specialists in education will select the most important literature published in their respective fields for the "Record of Current Educational Publications," issued by the Office of Education. For eighteen years, the "Record" of the most important material on seventy-nine different phases of education has been prepared in its entirety at intervals of three months by the library division of the Office of Education. Now the seventy-nine phases of education have been divided into fourteen major groups. An outstanding specialist in each of the fourteen fields has been invited to submit, quarterly, a list of the notable literature in his particular field appearing in educational magazines, important books, reports, proceedings, and other publications. Their first selections for the quarter, October to January, were expected from the press in February, 1931.

The specialists who have agreed to help the Office of Education make the "Record of Current Educational Publications" a highly selected list of the best material from the educational press, and their fields, are: Arthur J. Klein, Ohio State University, collegiate and professional education; W. C. Eells, Leland Stanford Junior University, junior college; L. V. Koos, University of Chicago, secondary education; Ernest Horn, State University of Iowa, elementary education; Edna Dean Baker, National Kindergarten and Elementary College, nursery-kindergarten-primary education; Carter Alexander, Teachers College, Columbia University, public school administration; M. E. Haggerty, University of Minnesota, educational psychology; E. S. Evenden, Teachers College, Columbia University, teacher-training; Edwin Lee, University of Californin, vocational education; Alonzo G. Grace, University of Rochester, adult education; Elise Martens, office of education, education of exceptional children; James F. Abel, Office of Education, foreign education; Ambrose Caliver, Office of Education, education of negroes; and Martha McCabe, Office of Education, proceedings, summaries, courses, etc.

In adopting this method of collecting material for the "Record of Current Educational Publications," the Office of Education expects to make available a list of writings covering completely and qualitatively every division of education.

Circulars of the Office of Education—Circular No. 15, May, 1930, is a brief inquiry regarding general supervisors provided for kindergartens, primary, and elementary grades, addressed by the Office of Education to superintendents of schools in towns and cities having populations of 2,500 and more. The term "general supervision" is used in contra-

distinction to the term "special subject supervisor" which is commonly applied to supervisors of music, art, penmanship, etc. Replies from 1,540 superintendents have been summarized in this circular. This summary gives information regarding general supervision provided for kindergarten-elementary grades: (1) the different officers responsible for general supervision; (2) the percentage of cities of different population size reporting general supervisors in their school systems; (3) the variety of grade units or combinations of grades assigned to general supervisors; and (4) the grade units or combinations of units used most frequently in cities of different population size.

Of the 1,540 superintendents replying to the inquiry, 620 report that general supervisors are responsible for the supervision of instruction for the kindergarten-elementary grades. This is 40 percent of the total number of replies or 57 percent of the number of cities reporting some form of general supervisory programs.

A total of 907 general supervisors are engaged by the 620 cities reporting. Other officers reported as responsible for supervisory programs include supervising principals, the superintendents of schools, and supervising teachers. The size of the city materially influences the appointment of general supervisors of instruction.

Circular No. 8, April, 1930, is a bibliography of recent contributions to the literature of early childhood education, issued by schools and professional organizations.

Translation of Educational Classic—A long search, unavailing in the United States, extending to Europe and finally ending in the Home House of the Christian Brothers in Belgium, will make available for the first time to American students of education an English translation of the original edition of Jean Baptiste de la Salle's *School Management*, a book which profoundly influenced education over a period of three centuries. The English translation of this classic is being made by Professor F. de la Fontainerie of the University of Pennsylvania, and the book will be included in the group of McGraw-Hill *Education Classics* under the general editorship of Professor Edward H. Reisner of Columbia University.

After discovering a copy of the original edition of *School Management*, first published in 1721, in the library of the Christian Brothers, the editors had other difficulties to face before the volume could be prepared for publication. The original edition was printed in French and it had never been translated into English. While the Christian Brothers were willing and anxious to help the editors in their quest, they would not consider permitting this valuable book to leave their archives. Finally, a Brother Philip, who is connected with the Home House in Belgium, resolved upon an arduous but nevertheless successful plan of operation. He arranged to have one of the Brothers of the Home House go into the archives of the Society and copy *School Management* word for word, by hand. This long task has been completed and the copy is now in the United States.

Admission to First Grade in Massachusetts—The Bureau of Research and Statistics of the State Department of Education reports a detailed distribution of Massachusetts towns and cities in terms of age requirements for admission to the first grade as of September 1, 1930.

The median age of admission is five years and six months. The age of six

years is required in seventeen towns and cities. The larger number of towns and cities, however, are in the five years and eight months group.

In Boston, Brookline, Cambridge, Easton, and Stoneham, children are admitted to Grade I after completing one full year in kindergarten.

Children are admitted to the first grade on mental age as established by mental examination in Bourne, Carlisle, Carver, Falmouth, Leominster, Melrose, Northborough, Northbridge, Plymouth, Southborough, Stockbridge, Stoneham, West Newbury, and West Springfield.

Statistics for Vocational Education—The annual report of the Federal Board states that more than a million persons, young and old, were enrolled in vocational schools in 1930, including 170,000 who were learning to farm better, 250,000 learning to make better homes, and 625,000 seeking to do some specific job more skillfully in trade and industry. This enrollment was largely in schools that received aid under the terms of the national vocational education act, and all of the registration was in vocational courses organized and conducted under a joint federal and state plan of vocational education.

Vocational education is carried on in the classroom, shop, factory, and on the farm. Under the national vocational education act, which is administered by the Federal Board for Vocational Education, three types of schools have been set up in each of the states: the day school for the boys and girls who have chosen an occupation and desire training in it, the part-time school for persons who are employed and can devote part of the day to instruction and training, and evening schools for workers who desire to devote time outside their employment hours to improving themselves in the occupation in which they are engaged.

Instruction in these schools reaches into every kind of employment requiring a measure of technical or mechnical skill. Practical farm courses, courses covering trade and industrial occupations such as the building trades, mining, and specific lines of manufacturing; and courses in home making for girls and women are provided in these vocational schools. Instruction is open to the white and colored races alike.

The Board's report shows that the largest enrollment of vocational education students last year was reported by the part time schools in which more than 418,000 received instruction. The evening schools enrolled over 341,000 students, while in all-day schools the enrollment was more than 300,000 students.

The need for modern equipment is pointed out and it is urged that schools purchase equipment only after determining definitely that it will be usable over a reasonable length of time. In a number of schools, boys and girls are being trained for occupations which have practically ceased to exist, because of the fact that equipment, purchased at considerable expense some years ago, continues to be used.

Other conclusions reached are that: the vocational school should not be a dumping ground for backward pupils; vocational education is for adults as well as for the younger generation; broader vocational courses are essential; "fixed-time exposure" courses are impractical; practical experience is essential for vocational teachers; and vocational education differs from vocational guidance, the Board being permitted only to promote the former.